

POPULAR SCIENCE

MONTHLY

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AUTOMOBILES • HOME & SHOP • MECHANICS

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Destroyer Hitting Power

PAGE 73



Your Voice Is You...

Do you realize the value of a smile when telephoning? It helps a lot. Of course, the other person can't see you but the smile is there just the same. It's in your voice. And it reflects a friendly, cordial personality.

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BELL TELEPHONE SYSTEM

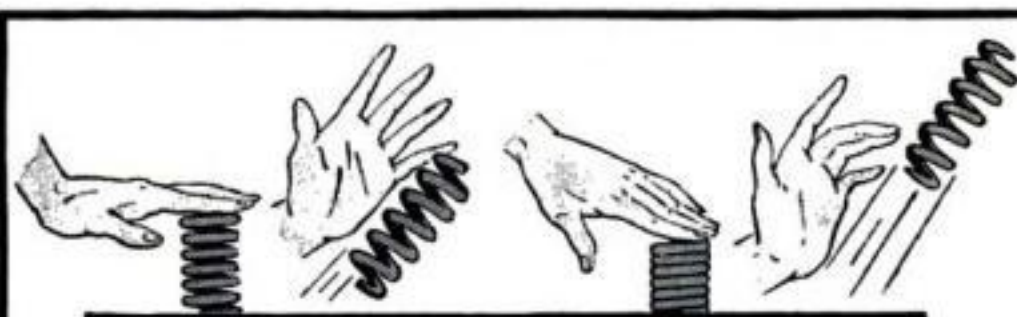


THE BELL SYSTEM IS DOING ITS PART IN THE COUNTRY'S PROGRAM OF NATIONAL DEFENSE

Inside Story on How THIS POWERFUL ENGINE PUTS THE SQUEEZE ON GAS

Super-High Compression Gives New Plymouth Engine Unusually High Efficiency

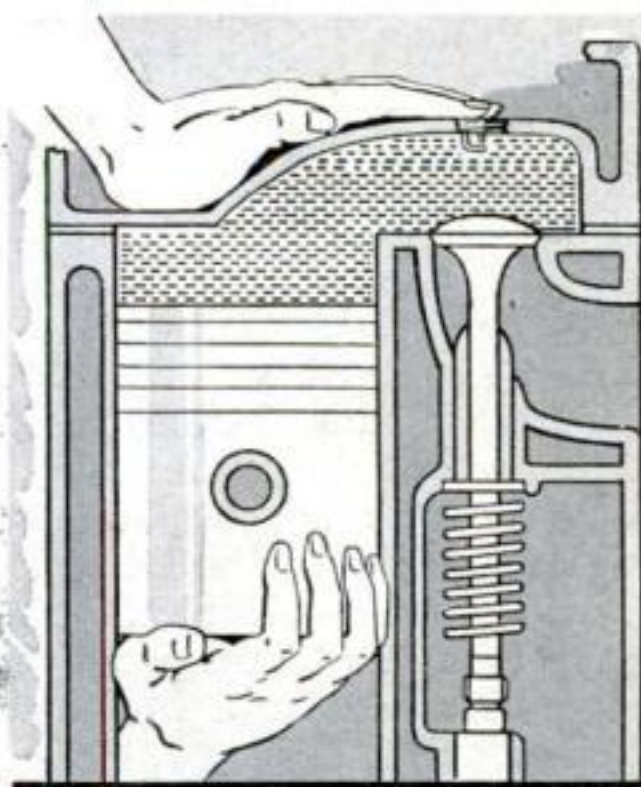
A HIGHLY IMPORTANT factor by which engineers gauge an engine's efficiency is its "compression ratio"...good tip for the buyer with an eye out for economy!



Compressing Gas is Like Compressing a Spring

THE MORE YOU COMPRESS a coil spring before releasing it, the harder it will rebound. Similarly, the more the gasoline mixture drawn into an engine is compressed before being ignited, the more *power* its combustion will produce for you! Compression ratio of the 1941 Plymouth engine

is *super-high*—6.70 to 1—highest of "All Three" low-priced cars! Gas is squeezed down to less than *one-sixth* of its original volume...to make it carry you farther!



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2. Four Rings Per Piston (in-

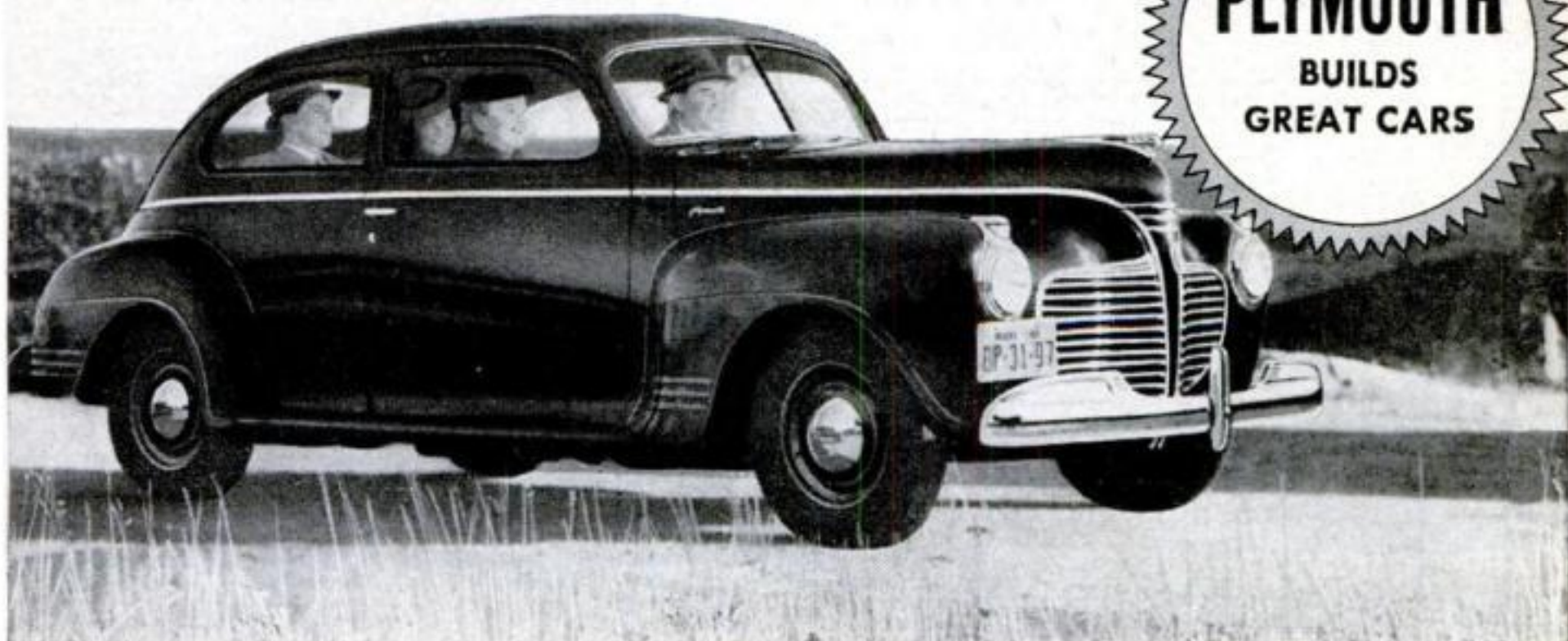
stead of the usual three) to safeguard against compression loss;

3. Directional Cooling and Full-Length Water Jackets which quickly remove the heat of high compression, and

4. Patented Floating Power Engine Mountings which make

such high compression possible without roughness. Plymouth Division of Chrysler Corporation.

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POPULAR SCIENCE

FOUNDED 1872

MONTHLY

VOL. 138 NO. 3

Mechanics & Handicraft

THE NEWS PICTURE MAGAZINE OF SCIENCE AND INDUSTRY

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B. G. SEIELSTAD has let hardly an issue of Popular Science come out in the last 12 years without at least one of his meticulous drawings of complicated gadgets, to say nothing of the "little men" who enliven Readers Say. Si started as a newspaper artist in Los Angeles in 1905. He says he has too many hobbies to be much good at any one.

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*Postpaid in U.S.A.

Name.....
Street..... State.....
City..... Year.....
My car is a..... (MAKE)

PS 31

**World's Oldest and Largest Manufacturers
of Automotive Chemicals**

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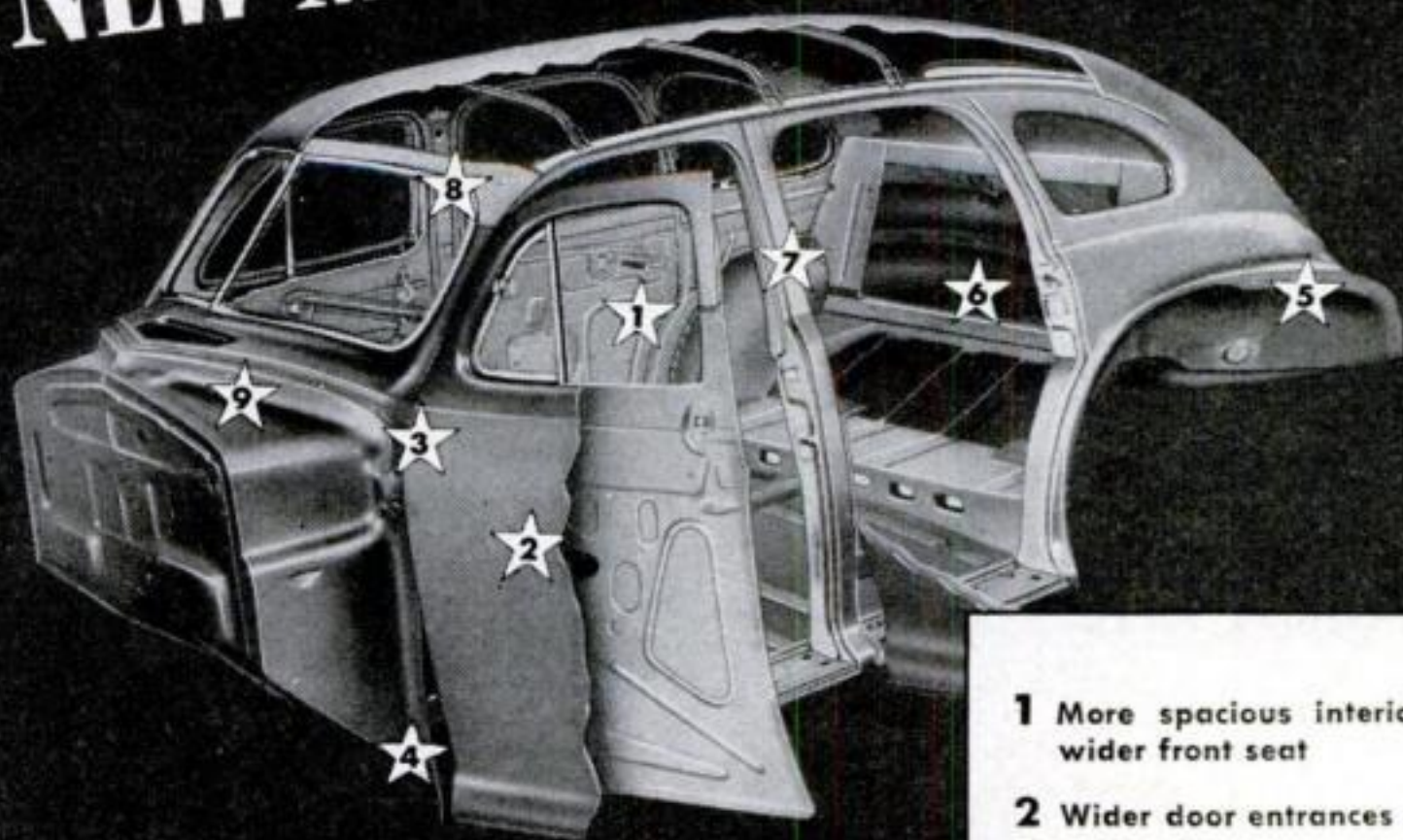
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A NEW MEASURE OF ROOM



- 1** More spacious interior with wider front seat
- 2** Wider door entrances
- 3** Door swing-stops hold doors wide open for more convenient entrance and exit
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- 5** New steel reinforcements front and rear
- 6** More available space in luggage compartment
- 7** Dome light operates automatically as well as manually
- 8** New sliding panel sun visors
- 9** Scientific insulation with thick rock wool pad on both sides of cowl

DESPITE the more sleekly streamlined appearance of the new Unisteel Turret Top Body by Fisher, it is actually roomier than ever. Note, for instance, how it adds to the spaciousness of the 1941 Oldsmobile Dynamic Cruiser De Luxe illustrated here. Its inside seating width is increased 6 inches in favor of front-seat passengers. And the rear seating width is $4\frac{1}{4}$ inches greater. Note, too, in the panel on the right some of the other outstanding comfort and safety features that apply to the new Body by Fisher on General Motors cars in every price class. You can see there are good reasons for saying, "Body by Fisher is '41's guide to better value"—which leads you, of course, to a General Motors car.

They're saying the new Oldsmobile's "the car that has everything modern!"—and there's a major reason for that in the new Body by Fisher on the 1941 Oldsmobile Dynamic Cruiser De Luxe; with its concealed running boards, foam rubber seat pads, almost 6" more over-all length and 8" more over-all width.



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MARCH, 1941

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Coming Next Month—

“KILL THE BABY!” That’s one of the orders frequently heard on the Hollywood sound stages, but there’s no infanticide involved. It’s just the camera man’s way of saying that he wants a small spotlight cut out. To add some other odd phrases to your vocabulary, read “Slang Rules the Movies.” It tells you what they mean when they say, “Hang a bear trap and give it barn doors and a gobo.”

NOBODY’S INDIFFERENT to color. Dr. Gilbert Brighthouse, psychologist at Occidental College in Los Angeles, gives proof of that. He has learned what it was that made Papa pick out a blue tie to wear this morning. He knows why poor children prefer candy bars wrapped in flaming red . . . why rich youngsters take their sweets in a greenish jacket. These mysteries of the rainbow’s hues are described in “Secrets of Color.”

IT TAKES A GOOD MAN to be a parachutist in the armed forces of the United States. The trials he must face, the arms he must carry, and the money he makes are revealed—plus pictures—in “School for Sky Soldiers.” Pull that rip cord! It’s good to the last drop.

THE SUPER GAME BOARD is here, and you can make it yourself. It can be used indoors or out for eight games ranging from shuffleboard to tenpins. Charles and Bertram Brownold give you the plans in “Game Court.” They give you, too, an unadvertised ninth pastime—the fun of building it.

WHAT’S NEXT IN WAR? What new tricks must the infantry learn? Will all the tanks of the future be massive ones? And how about airplanes—will all fighter planes eventually be equipped with turrets for guns? America’s Army and Navy officers are going back to school to learn the answers. Carl Dreher furnishes some of them in “Military Education—1940-41.”

A PLANETARIUM, as anyone will tell you, is a highly complicated instrument that costs hundreds of thousands of dollars—which means that only a large metropolis can have one. But three amateur astronomer-mechanics put their heads together to make a planetarium for a museum at Pittsfield, Mass. How they did the job for \$250, using furnace parts and other odds and ends, is told in story and pictures.



"Ma Says It Tastes of Coal Oil!"

MA IS probably right. The clerk who had to fit shoes and horse collars, measure out nails and putty, and draw kerosene couldn't always stop to wash his hands before he handled the butter and crackers. And every so often the potato on the spout of the oil can would joggle off.

Today, for most of us, the mixture of food and kerosene odor has ceased to be a problem. More and more of our food, packed by electric machines, comes to us in sanitary containers. Electricity does the work, too, of washboard and carpet beater. Automobiles and good roads have shortened distances to town and work. And be-

cause so many of the routine, unpleasant jobs which occupied our parents' time are now only memories, we have more opportunities for enjoying life.

Practically every industry in America has helped to bring about this progress. And every industry, in doing so, has made use of the economies and manufacturing improvements that electricity brings. General Electric scientists, engineers, and workmen have been, for more than 60 years, finding ways for electricity to help raise American living standards—to create More Goods for More People at Less Cost. Today their efforts are helping further to build and strengthen the American way of life.

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*From the
News Editor's
Desk*

TWENTY MILLION DOLLARS A YEAR may be put into the pockets of American farmers and manufacturers as the result of a discovery announced by scientists of the Pabco Industrial Research Laboratories, San Francisco, Calif. From an American-grown bean, researchers have extracted a substitute for tung, or China wood, oil, valuable as an ingredient of paints, varnishes, and lacquers. A two-year test of the substitute oil, it is said, has shown it to be superior to the original product.

THE MANUFACTURE OF SYNTHETIC SAPPHIRES for use as jewel bearings for watches and scientific instruments may soon become a new American industry. Several companies are already producing them in this country to replace the supply formerly imported from Europe.

BOMBING PLANES BY THE ASSEMBLY-LINE METHOD, huge defense assignment to the automotive industry, is being speeded by a unique exhibit in a disused Detroit automobile plant. Set up by the Automotive Committee for Air Defense, the exhibit consists of just two bombing planes, a twin-engine, Martin B26 and a four-engine Consolidated B24. The planes are dismantled and their thousands of parts and respective blueprints are on display. Any manufacturer able to duplicate a part prepares estimates of its cost and his capacity to make it, which he submits to the Government. Virtually all parts have been spoken for, and when the anticipated contracts for 12,000 of the ships are let, the Government will know exactly where to turn for any parts the plane manufacturers themselves are unable to supply.

JETS OF AIR from tiny nozzles along the wings and bodies of bombers and fighting planes now promise to increase their range and speed. At the Case School of Applied Science, Cleveland, Ohio, Prof. John R. Weske has found that stale air, within an inch and a half of the plane's surface, piles up eddies, increases skin friction. His high-pressure jets wash off the eddies and keep the air flowing smoothly.

GLYCERIN, essential in the manufacture of cordite and nitroglycerin, is now made from petroleum. Engineers of the Shell Development Co., Emeryville, Calif., have developed a process in which propylene is isolated from petroleum, allyl chloride is formed by a reaction with chlorine gas, allyl alcohol results from treatment with caustic soda, and glycerin chlorhydrin is formed in an alternate process. Glycerin itself is produced from one of the last two products. Its quality is said to be "excellent," and hopes are high that the scarcity of 1917 may be avoided. Glycerin is normally a by-product of soap.



I Jumped My Pay from \$18 to \$50 a Week!

Here's how I did it

by S. J. E.
(NAME AND ADDRESS
SENT UPON REQUEST)



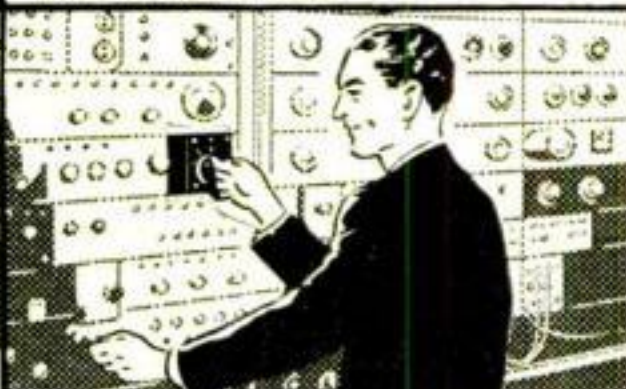
"I had an \$18 a week job in a shoe factory, but desired to make more money and continue my education. I read about Radio opportunities and enrolled with the National Radio Institute."



"The instruction I received was so practical I was soon able to earn \$5 to \$10 a week in spare time servicing Radios. This paid for the N.R.I. Course and led to service work paying for my college education."



"Radio servicing permitted me to attend school and work evenings and week-ends. Upon completing the N.R.I. Course I was made Service Manager at \$40 to \$50 a week, more than twice my shoe factory wage."



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Readers Say:

He'd Never Thought of Building a Boat—But Look at It!

THIS past spring, I was taken with an insane desire to build a boat. Browsing through stacks of magazines, I stumbled onto the plans for a 13-foot stepless hydroplane planked hull in P.S.M. for July 1935. I had never even thought of building a boat before. Just six months to the day from start of construction, the hull was finished and launched. With a 16-horsepower motor, the *Marle-Jo* planes along at 32 miles an hour. Thanks for a swell time. P.S.M. is tops with me.—T. H., Marion, Ind.



How's This for a Secret Weapon?—Hollywood's 6,000-Shooter

IF UNCLE SAM is looking for new war inventions, why doesn't he take a tip from the movies? In all the "westerns" I have seen (and I like 'em) I have never seen a case



where either the hero or the bad man had to load his gun. They just empty them and shove 'em back in the holster, and lo and behold, the next time the guns are ready to give another six broadsides. Uncle Sam might get something here—a gun you never have to load.—W. P. O., Port Angeles, Wash.

But it only works if you're fighting studio redskins.—Ed.

If You Don't Believe It, Try It Yourself

A STACK of ten silver dollars is an inch high. Suppose you drilled holes in enough silver dollars to equal the national debt, and strung them on a wire. How many times would they reach across the United States? I'll give you the answer: you have \$10 to the inch, \$120 to the foot, \$633,600 to the mile. It would take \$2,027,520,000 to

NEW ONES, OR "CART WHEELS" THAT'VE BEEN AROUND?



reach once across the U.S. The amount of the national debt would reach across 25 3/5 times.—W. H. Y., Severance, Colo.

The Other Side of the Question of War-Machine Articles

WHILE I respect the opinion of H. F. W., who protests against your publishing so much about war machines, I disagree with him. As long as there

H'M, MAYBE I CAN GET SOMETHING OUT OF THIS!



are people on earth there will be war, and an army is a necessity. We young fellows will be put into military training and such articles as are run in P. S. M. will show us the different branches of the Army and we can decide which we would like best—even if we don't get the choice. P.S.M. presents

the material in a more interesting manner than most papers and magazines.—R. M. M., Kings Valley, Ore.

It Must Have Been Handy on Moving Day

WHEN my father was alive, he could lay his hands on the top of any oak table and walk backward, and the table would rise off the floor and follow him. He could do this for 15 minutes or so, when he would have to stop and rub his arms. Maybe he was just trying to make it mysterious, but he said he had to concentrate on it and have his thumbs touching before it would work. I've never seen anyone else who could do it.—L. G. M., Minneapolis, Minn.

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- ☐ Legal Counsellor
- ☐ Office Manager
- ☐ Secretary

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(Any other)

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Readers Say:

R.T.S. Didn't Realize the Gravity of the Situation

IN HIS problem about the steel ball suspended inside the hollow sphere, R. T. S., of Kirkland Lake, Ont., did not take into account the gravitation of the earth. In order to make the smaller ball stay in the center of the larger, it would be necessary to have another body exerting the same gravitational force as the earth but in the opposite direction. I hope R. T. S. does not try this as an experiment, for such a



body would cause considerable havoc on the earth and would require the astronomers to figure out the solar system all over again.—C. S. G., Sheffield, Pa.

A Warning on Reproducing U.S. Postage Stamps

REPRODUCING postage stamps by contact printing as you described in the December 1940 issue may be O.K. for the stamp collector who merely wants a record for his own use, but he'd better watch out for the United States Secret Service. My interpretation of the Federal law is that it is illegal to photograph or reproduce in any way a postage stamp, except in connection with philatelic articles in magazines, books, catalogs, and the like. I thought you might like to pass the word along to your readers.—F. D., Chicago, Ill.

His Daddy Got the Idea from Reading P.S.M.

The young man in the picture is my son, Carl Dane Thusgaard, and he evidently approves of the bottle holder I rigged up for him. As a regular reader of P.S.M., I couldn't see any reason for the back-breaking job of bending over to feed the baby. In addition to saving his mother a lot of work, it gives Carl a chance to come up for a breather now and then.—C. T., Jamaica, N. Y.

Congratulations to C.T. on his ingenious application of scientific principles to an important domestic problem.—Ed.

George Ellery Hale's Teacher in Machine Design

YOUR article on the Palomar telescope and the late Dr. George Ellery Hale was specially interesting to me, because I had the pleasure of giving George Hale his first lessons in machine design in 1884, while he was a pupil of the Chicago Manual Training School. I remember how proud George Hale was of the first eight-inch photograph he made of the moon—and, really, I have never seen a better. He was then 17 years old.—E. B. F., Mount Dora, Fla.

They Just Put on Their Ties To Have Their Pictures Taken

FOR A column of "What's Wrong with This Picture?" I offer the following items, all in your January issue:

Three different photographs show men operating power tools while wearing neckties. One on page 18 is using an electric hand tool; one on page 157, a band saw; one on page 167, a lathe. This is dangerous, as the necktie may get caught in the work.—F. A., Dunmore, Pa.

WELL, DO SOMETHING!



A Stitch in Time Removed the Ring

A FEW years ago, my wife was opening a cardboard box with a butcher knife, when she cut a small artery in her wrist. Soon afterward her hand began to swell and we tried without success to remove her wedding ring. I remembered reading in P.S.M. that if you thread a needle and wind the thread from the finger tip until you reach the ring, then slip the needle under the ring and unwind the thread, the ring will slip off. And that's exactly what happened.—A. T. O., Omaha, Neb.



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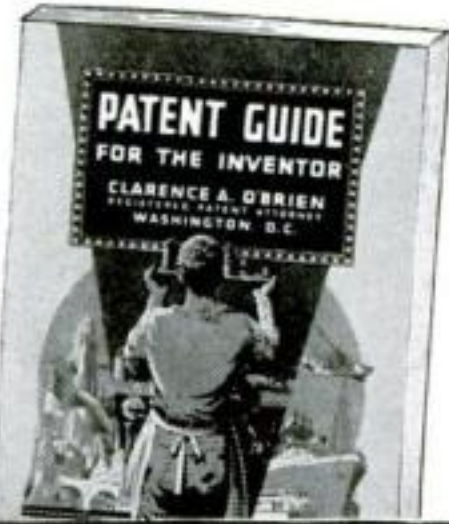
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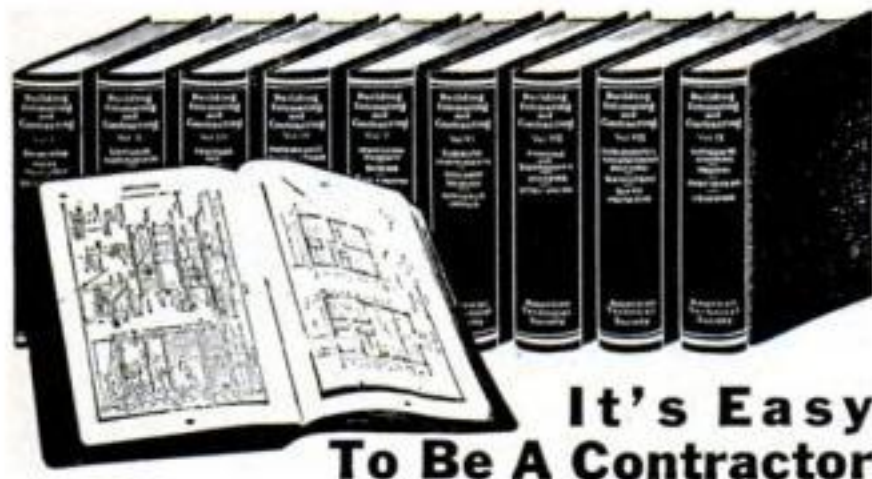
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| <input type="checkbox"/> Bookkeeping | <input type="checkbox"/> Commercial | <input type="checkbox"/> Cost Accounting | <input type="checkbox"/> French | <input type="checkbox"/> Salesmanship |
| <input type="checkbox"/> Business Correspondence | <input type="checkbox"/> C. P. Accounting | <input type="checkbox"/> First Year College | <input type="checkbox"/> Grade School | <input type="checkbox"/> Secretarial |
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| <input type="checkbox"/> Cartooning | <input type="checkbox"/> First Year College | <input type="checkbox"/> First Year College | <input type="checkbox"/> Lettering Show Cards | <input type="checkbox"/> Spanish |
| <input type="checkbox"/> Civil Service | <input type="checkbox"/> First Year College | <input type="checkbox"/> First Year College | <input type="checkbox"/> Managing Men at Work | <input type="checkbox"/> Traffic Management |

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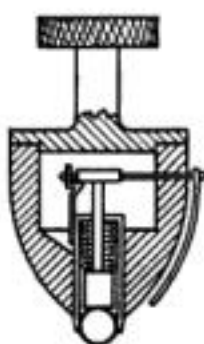
SKATES with rollers set in a blade shaped like that of an ice skate, to give greater speed and maneuverability, have been invented by Armand User, of Paris, France. For executing toe-stands and



other difficult figures of fancy skating, the skates have a small disk fixed in the toe of each. Just in case any energetic speed demons work up enough steam to overheat the ball-bearing rollers, the skates have vents built into the blade to direct a cooling stream of air on the bearings. . . .

EVEN THOUGH YOUR NEXT-DOOR

NEIGHBOR infringes on your patent rights, the local courts can't do anything about it. Only Federal courts have jurisdiction in patent suits. . . . **ACCORDING** to Patent 2,220,823, granted to John L. McKeown, of Winnetka, Ill., the patent "has for its primary object the provision of an improved game operating by chance." To this end he has used a flat, circular bowl with numbered pockets around its circumference and a small metal top which spins on a metal ball in its tip. In play, the top is spun within the bowl. When it runs down and falls over, a trigger in the side of the top releases the ball, which is projected by a



spring into one of the pockets. . . . **A GOOD LEGAL** definition of "invention" is so hard to find that courts have been known to state that the word defies definition. For that reason there are more rules stating

(Continued on page 22)

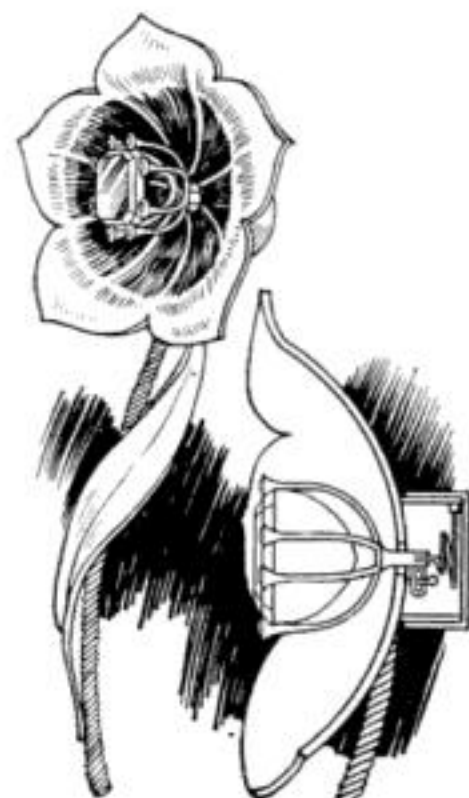
what is not an invention than there are describing what it is. . . . **GOLFERS** weary of playing the game in the conventional manner might try an invention of Ernest J. Savoy, of Oklahoma City. It consists of



a metal plate fastened to a shoe sole, with flanges in front of the toe in which "strikers" with sloped faces like those of golf clubs can be inserted. Using a standard golf ball and tee, a player does his nine or eighteen holes by kicking the ball around the course. . . . **UNUSUAL QUALITIES** of life and movement are claimed for a system of mounting natural or artificial gems in flowerlike reflectors. Devised by Edmond Foret, of New York, the rights to the invention have been assigned to Cartier, Inc. Mounting the stones on a light and very flexible spring which extends through the back of the reflector to a solid base permits them to respond to the lightest vibration by trembling and quivering. This produces ever-changing lights and patterns in the stone and the reflector. . . .

PATENT 2,224,808 is one for the tongue-twisters. It covers a process for causing an acetohalogenose to act upon polyhydroxyflavones

and polyhydroxyflavanones. Then there's number 2,225,419, which has to do with the 17-cis-alcohols of the cyclopentano-polyhydrophenanthrene series. . . . **RAIN, NATURAL OR ARTIFICIAL**, striking a micro-



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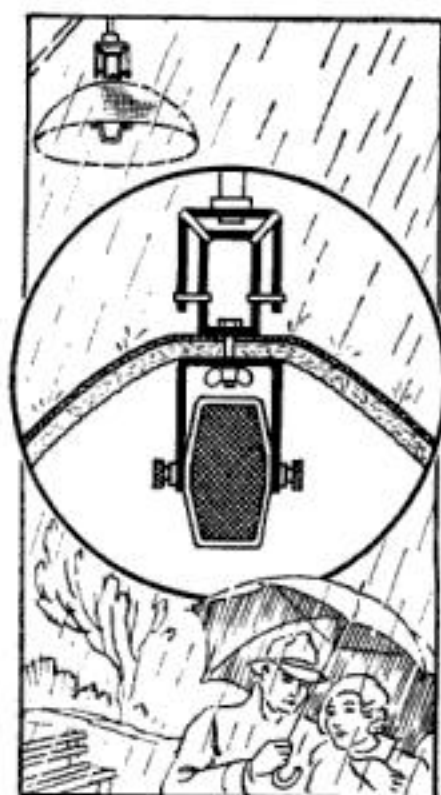
PSM-3-41

With the Inventors

(Continued from page 20)

phone often creates sounds which are most unlike rain. This frequently causes trouble for motion-picture producers filming scenes where rain is part of the picture, because these sounds find their way into the sound track. To overcome this difficulty, Byron

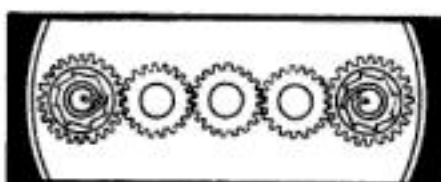
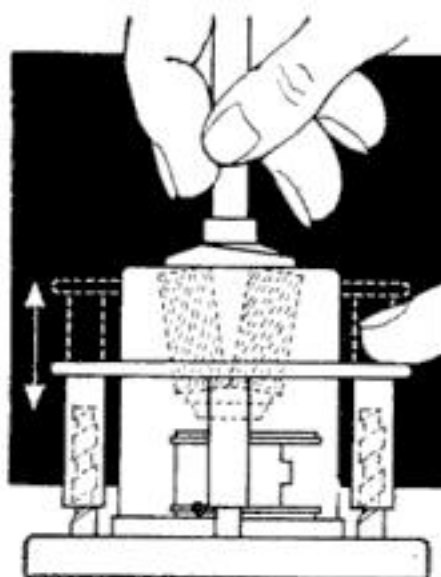
F. Ryan, of Los Angeles, Calif., invented a "rain umbrella" consisting of a fine-mesh screen and a piece of felt which is placed above the mike to shield it. The screen, on the upper surface of the umbrella, dissipates the rain-drops, while the felt absorbs them. Shellac on the under side of the felt keeps the water from leak-



ing onto the mike. . . . A PATENT on the combination of a pencil and a rubber eraser was once declared invalid because, the court ruled, there was no coöperation between pencil and eraser. When you use the pencil you don't use the eraser, and vice versa. For a valid patent on a combination, the

separate parts or elements must coöperate to produce a new result.

. . . SOMETHING DIFFERENT in the way of pencil sharpeners has been developed by Oliver D. Wallett, of Richmond Hill, N. Y. Instead of a crank to rotate the cutting blades, this sharpener has a driving mechanism like that of a ratchet screw driver. The pencil



is inserted vertically instead of horizontally, and the cutters are operated by alternately pressing and releasing a ring mounted around the outside of the machine. Ratchets keep the cutters from reversing when pressure on the ring is released.

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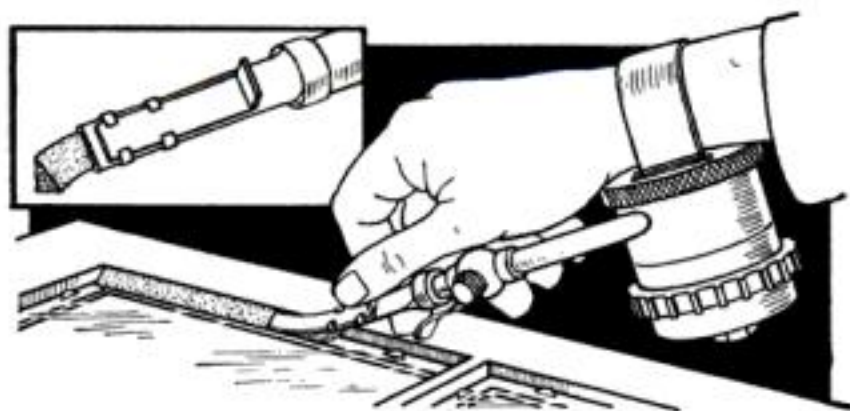
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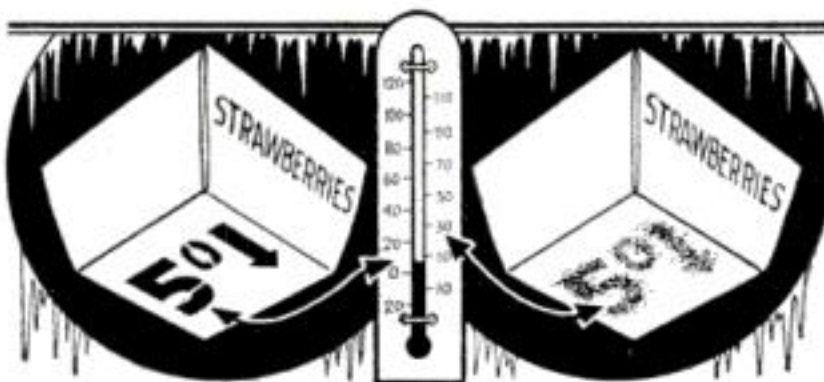


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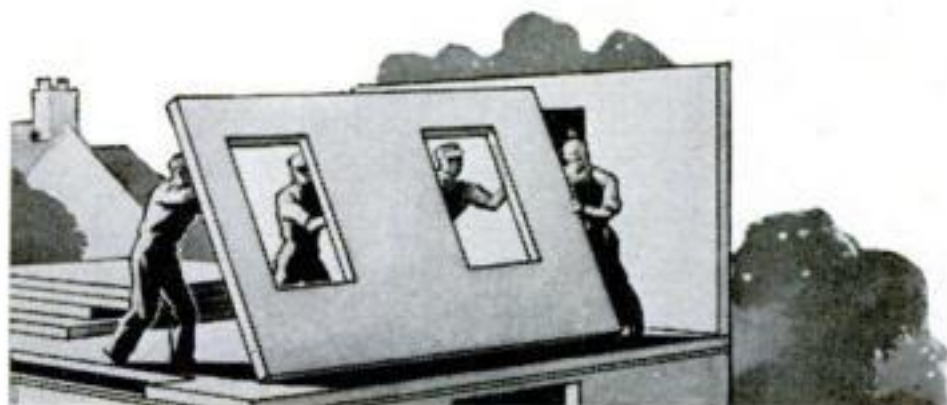
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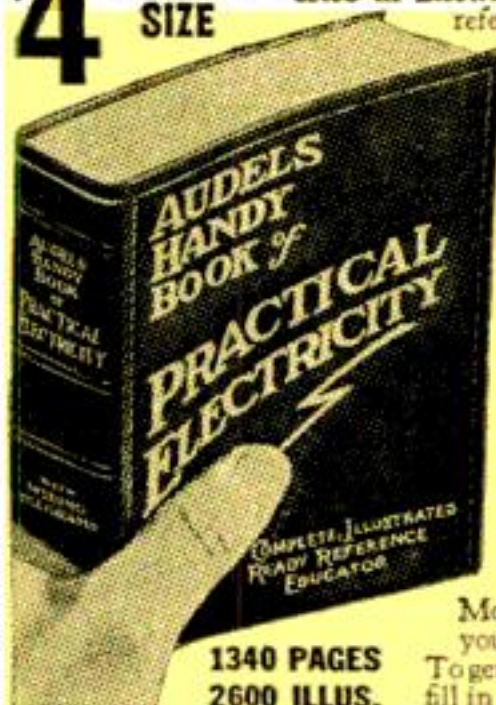
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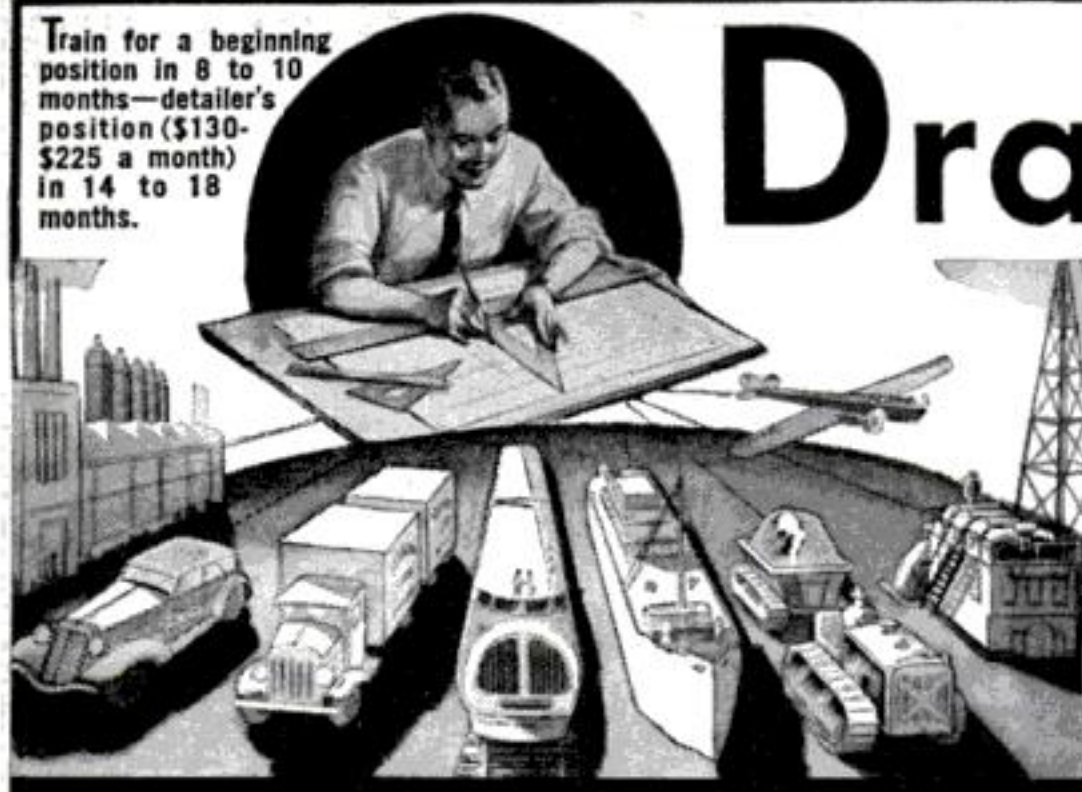
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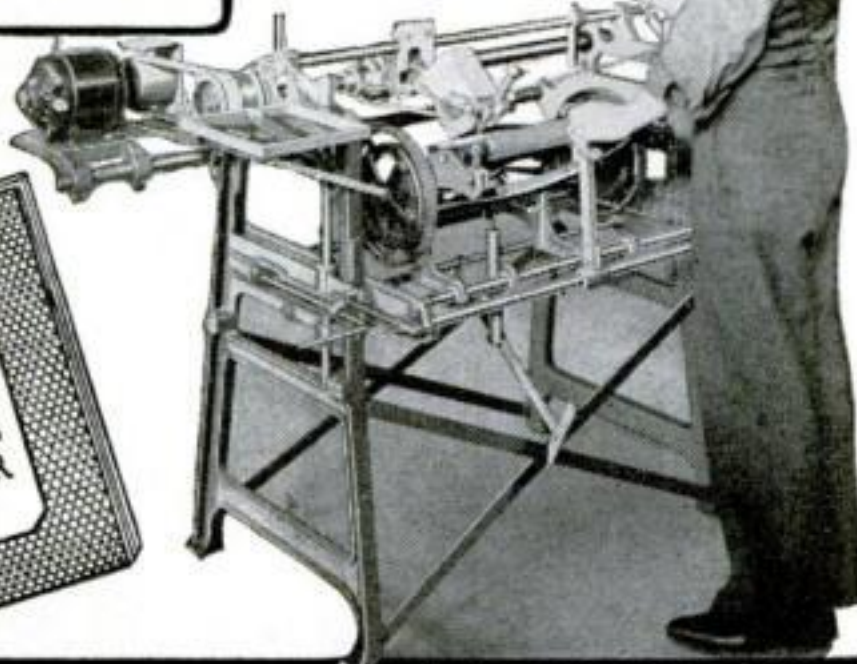
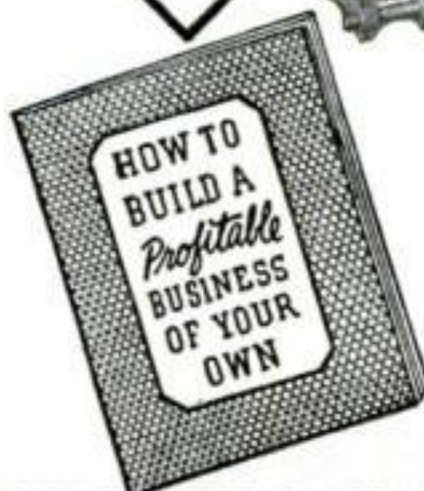
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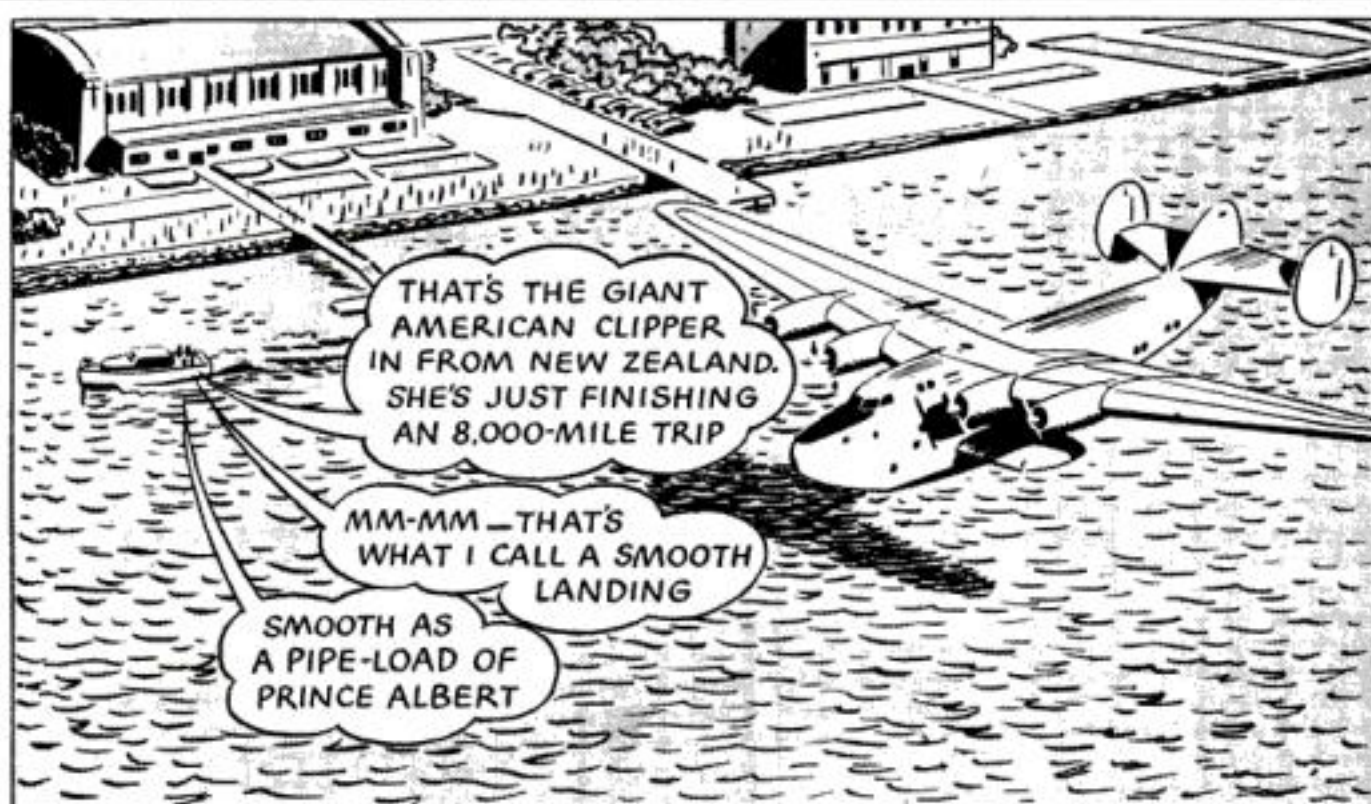
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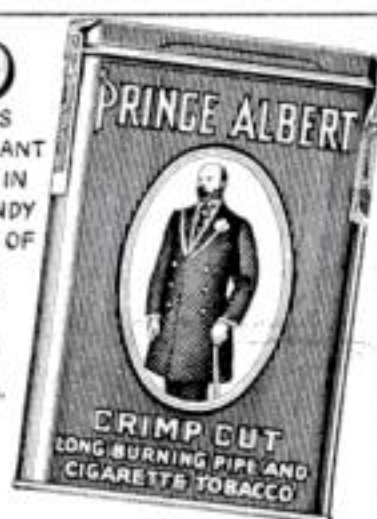
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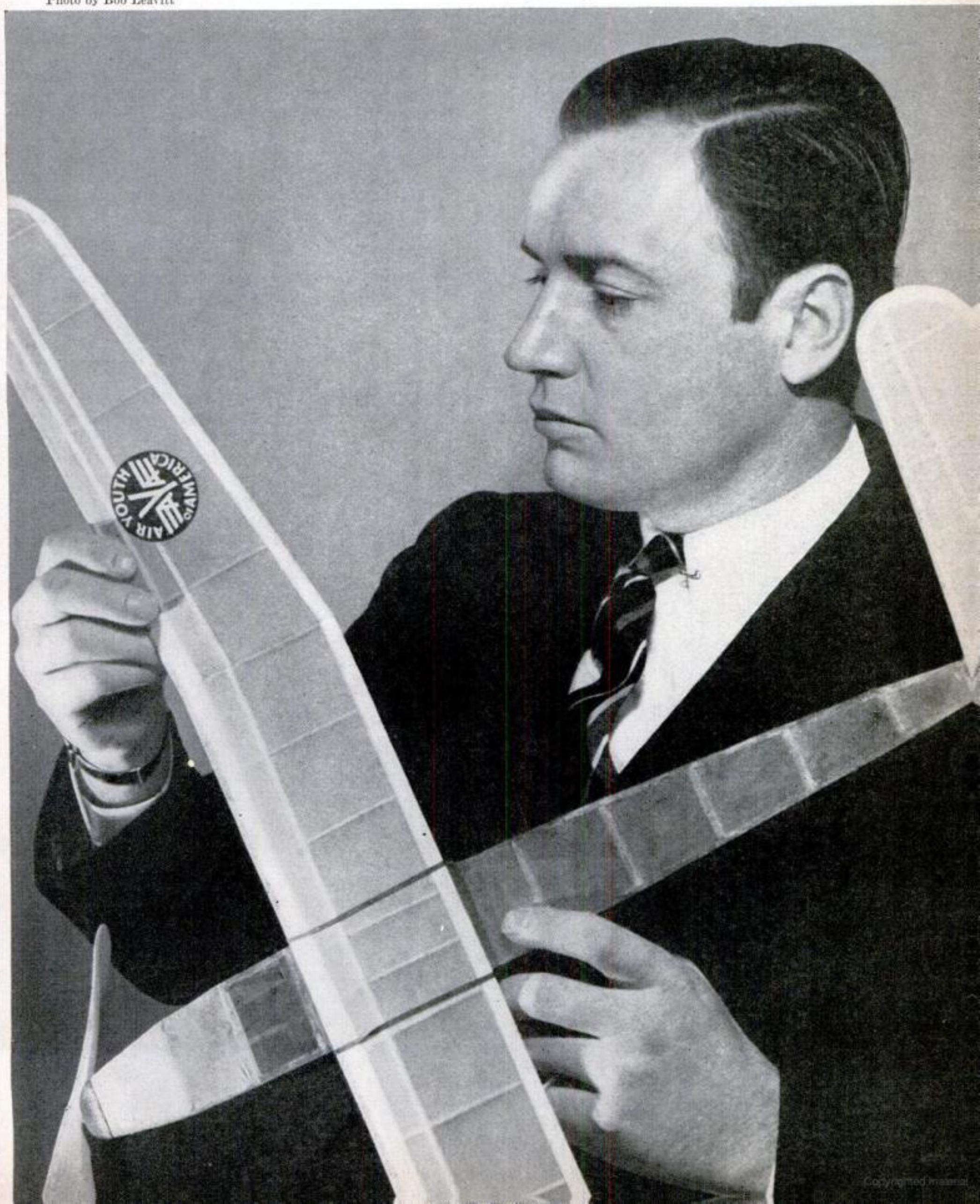
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THE NATIONAL JOY SMOKE

MAN OF THE MONTH

**Winthrop Rockefeller Builds Air Power
from the Groundling Up . . . (next page)**

Photo by Bob Leavitt





2,000,000 young Americans get boost to aviation careers

By JOHN HENNESSEY WALKER

AIR POWER clearly has become a prime factor in modern war—and there is no better way to build national air power than from the groundling up.

How well the great marching aggressor nations of our century—Germany, Russia, Italy—have learned this lesson is nowhere better shown than in their elaborate programs for “air-conditioning” their young people.

Germany, especially, has worked out a system which starts with flaxen-haired toddlers, too young to do more than cut out plane pictures and paste them in albums, and

follows the youngsters through, step by step, until they are full-fledged war birds at the ripe old age of 18 or thereabouts.

Russia makes up with proletarian optimism what she lacks in Teutonic efficiency, and announces that her popular aviation clubs (of which the youth program is an integral part) have 14,000,000 members. Even allowing for the pumped-up statistics that seem to be characteristic of the socialist commonwealth in action, there can be no doubt whatever that many millions of men, women, and children are involved in the project. Its members, don't forget, pioneered the technique of mass parachuting.

All this is regimented to the very hilt, of course, yet believers in the democratic system are fooling themselves if they think there is nothing more to it than that. The fact is, aviation has captured the imagination of young people all over the world as nothing else has done since the days when adolescent Spaniards and Englishmen looked westward over the stormy Atlantic and dreamed of what they might find there.

And the United States, which gave the airplane to the world for better or worse, has lagged sadly in taking up or developing this potential drive of the human spirit.

Yet now this nation has its own, all-American aviation program for kids. The name is Air Youth of America. There isn't an ounce of compulsion or regimentation in the whole project. It had a modest endowment to start with, and will finance itself with small club-dues payments.

In a sense, Air Youth is a memorial to the late Capt. Frank Hawks, gallant American flyer. Nearly three years ago Captain Hawks sought out Winthrop Rockefeller, young oil-company executive, and told how completely overwhelmed he was by letters and direct appeals from youngsters who needed help in finding themselves places in aviation.

Captain Hawks died in an air crash in August, 1938, but his idea has been carried on in the organization of which Winthrop Rockefeller



Arthur Mansfield, 16-months-old mascot of the Skyscrapers model club, can already handle planes without breaking them

Winthrop Rockefeller, as chairman of Air Youth of America, congratulates the winner of a model contest



To carry its equipment to distant meets, a Brooklyn, N. Y., club fixed up the elaborate trailer seen below



is chairman, and Thomas H. Beck, magazine publisher, is president. Air Youth has just begun its real organizational work after more than a year of careful preparation and preliminary activity. That year has not been any period of shadow-boxing, by the way. Air Youth, in its experimental days, managed to spread its services to 750 aviation clubs, with 20,000 boy (and girl!) members.

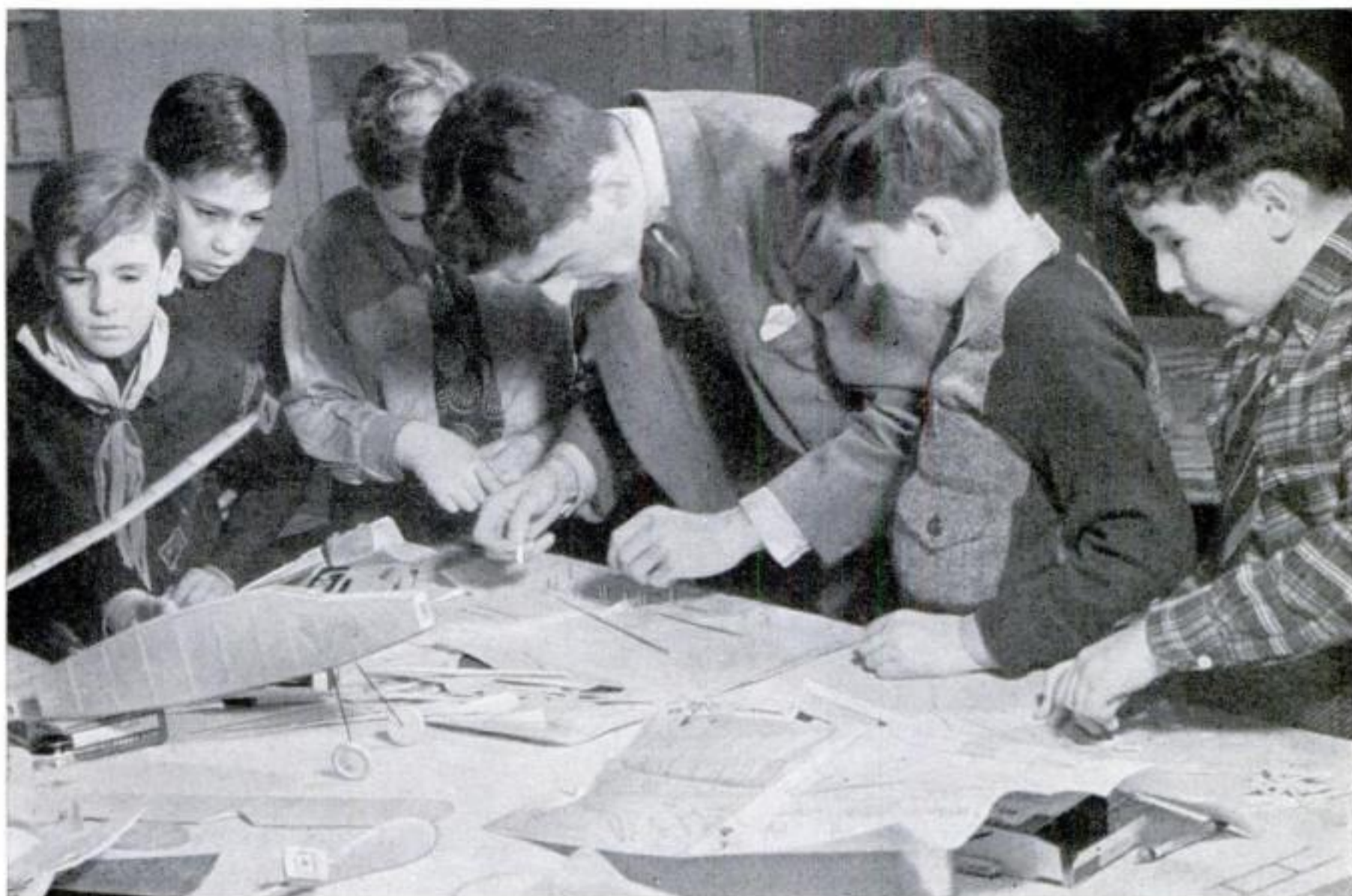
Painstaking national surveys showed Air

Youth two astonishing facts to start with: American youth is fanatically interested in aviation.

No one was doing much about it.

Despite the complete lack of central, cohesive organization, nearly 2,000,000 young Americans were building and flying model airplanes, the surveys showed. Yet a canvass of 32,000 schools disclosed fewer than 200 with organized aviation programs.

The real eye-opener came when the Air



Boys learn to think mechanically and use their hands, too, as they help to put a model plane together



Here's how a typical American model builder launches by hand a plane with a one-bladed propeller. It is powered by a rubber-band motor

Youth staff discovered the response that a couple of superficial, hit-or-miss commercial "clubs" had drawn. One of these so-called clubs, dreamed up as a minor promotion for a popular cereal, captured 500,000 child members, and the operators of the promotion didn't quite know whether to be delighted or appalled. Another such junior aviation scheme, run in very lackadaisical fashion by a newspaper chain, collected a quarter million young members apparently with no trouble at all.

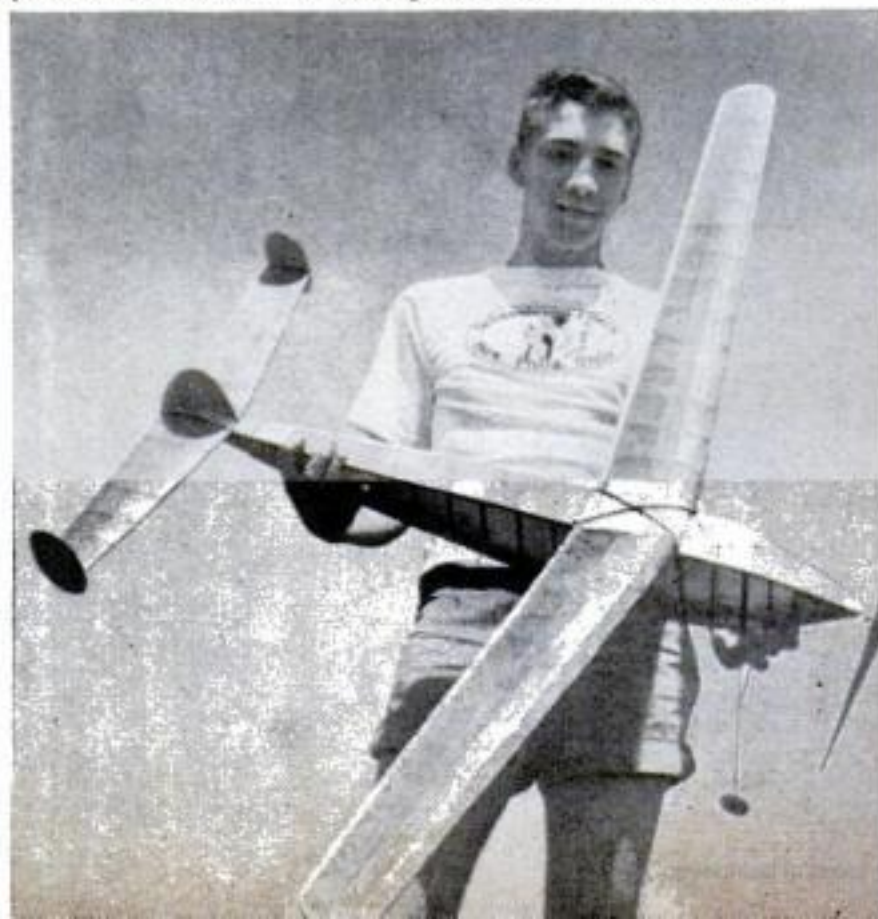
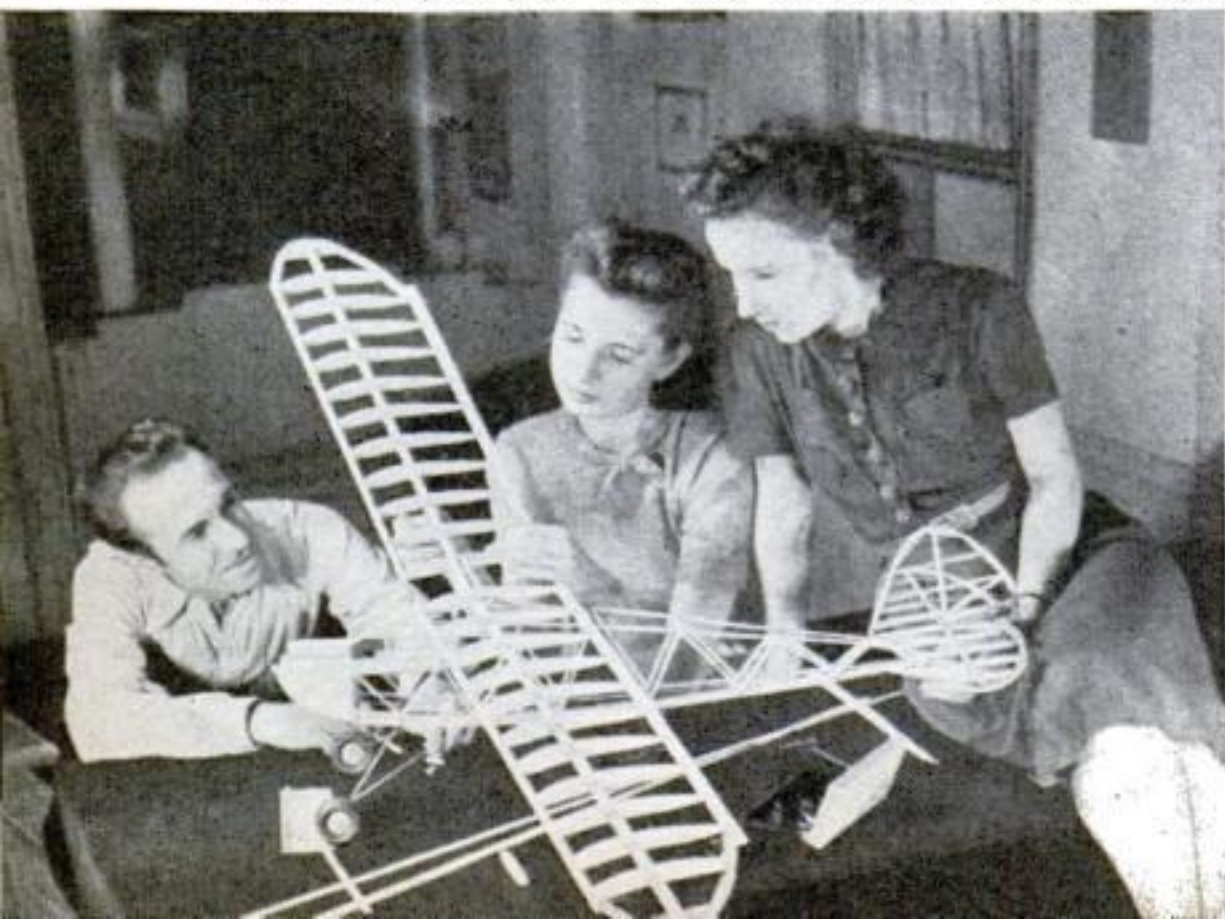
Another fundamental fact Air Youth discovered was that this field lacked textbooks or good printed material of any kind. The

organization's first move was to establish a monthly bulletin for interested clubs. Then the directors began distribution of a series of airplane-model building kits—five projects in all, ranging in cost from 10 to 50 cents. Just to give an idea, 125,000 of these were distributed before the organization even got down to serious operation.

A series of textbook manuals is in the works now. Number 3 of the series got itself published first, for an interesting reason. It is an authoritative rule book on how to set up and run model-plane flying contests, and the Boys Clubs of America put in a special appeal for such a book.

Air Youth has girl members, as well as boys, and they show plenty of skill with mechanical details

This is Max Wassman with the Moffett plane, rubber-band-powered, which he designed and flies himself



It was shoved ahead of schedule — that's the way Air Youth operates.

On the way is a complete book on vocational opportunities for young Americans in aviation. The author is Charles S. Mattoon, employment director for Curtiss-Wright in Buffalo, N. Y. It is to give straight information on the various fields of aviation—piloting, mechanics, administration, design, communications, meteorology, etc.—the needs and the chances and the prospective rewards, as well as the qualifications and training required, and how to set about getting them under your belt.

Air Youth considers its main function to be that of a central clearing house of information. With the preparatory year behind it, the organization has now begun to certify regular Air Youth of America Clubs as part of its permanent, nation-wide organization. It requires a responsible sponsor for each club—a local school, church, civic club, or the like. This sponsor is expected to take a permanent interest in its home-town air club and to be responsible for the annual dues, which are low but will give the main organization some continuing income of its own. The organizers suspect that one way *not* to interest or hold American boys is to offer them a glittering something for nothing.

What will it mean in jobs and vocational training for American kids? Let Winthrop Rockefeller answer:

"We have a main purpose, to guide and direct the tremendous interest in aviation that already exists among young Americans. After that, to help the boys who have a real chance for aviation careers, and to dissuade those who are not suited for these exacting jobs.

"We want to do two jobs—advancing aviation and exerting an influence for leader-



Nerves and muscles tense, August Streuning, of Maplewood, N. J., test-glides his New Ruler model, to check the control adjustments

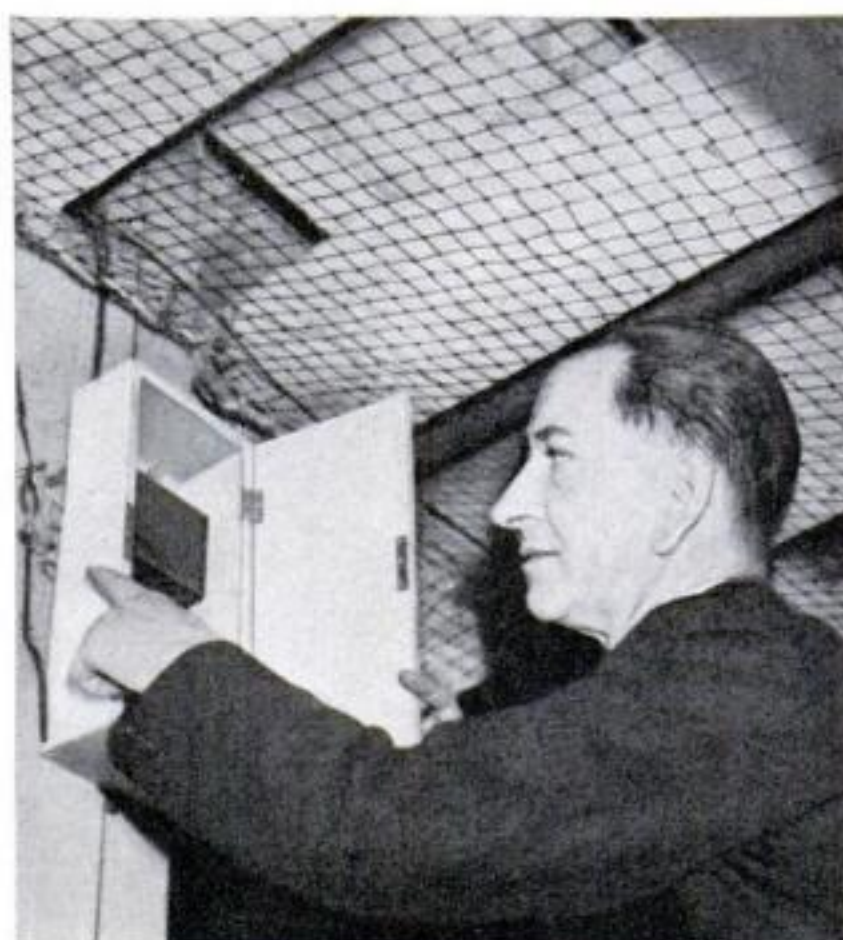
ship and for good citizenship in America."

There is no doubt that great opportunities are opening up in the expanding aviation industry, and that youngsters could find no better way of entering that career than by mastering the fundamentals taught by Air Youth. The organization doesn't need a second invitation to remind you that such aviation giants as the Wright brothers, Donald Douglas, Glenn Martin, and Igor Sikorsky began their life work by experiments with model airplanes.

An indication of what Air Youth plans to do can be seen in its first set of scholarships for older boys. These awards, valued at some \$4,000 a year, will finance study at such well-known institutions as the Casey Jones School at Newark, N. J., the Boeing School at Oakland, Calif., and the Spartan School at Tulsa, Okla.

Pads Protect the Ears from Air-Raid Blasts

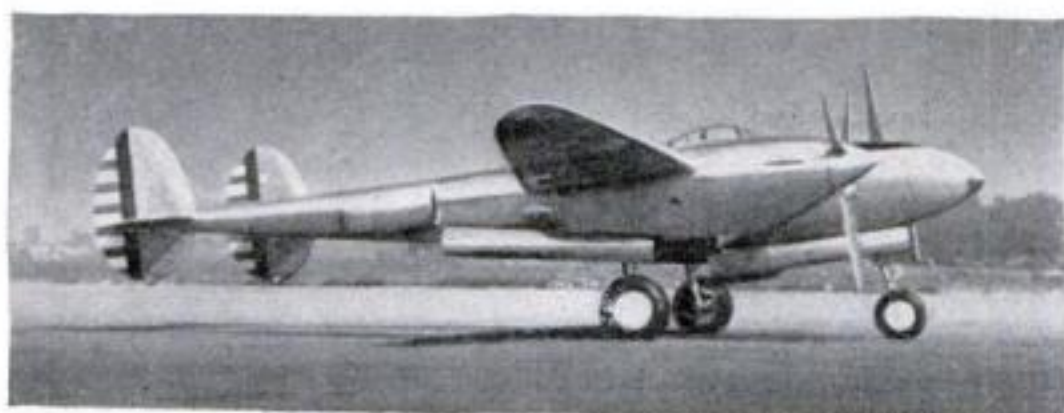
EAR PADS of sponge rubber are the latest style for British air-raid wardens, members of Local Defense Volunteers and other workers who must remain outside shelters and continue their work during air raids. They can easily be fitted over a respirator, and are said to disperse the blasts from explosions before they reach the eardrum, yet let the wearer hear conversation.



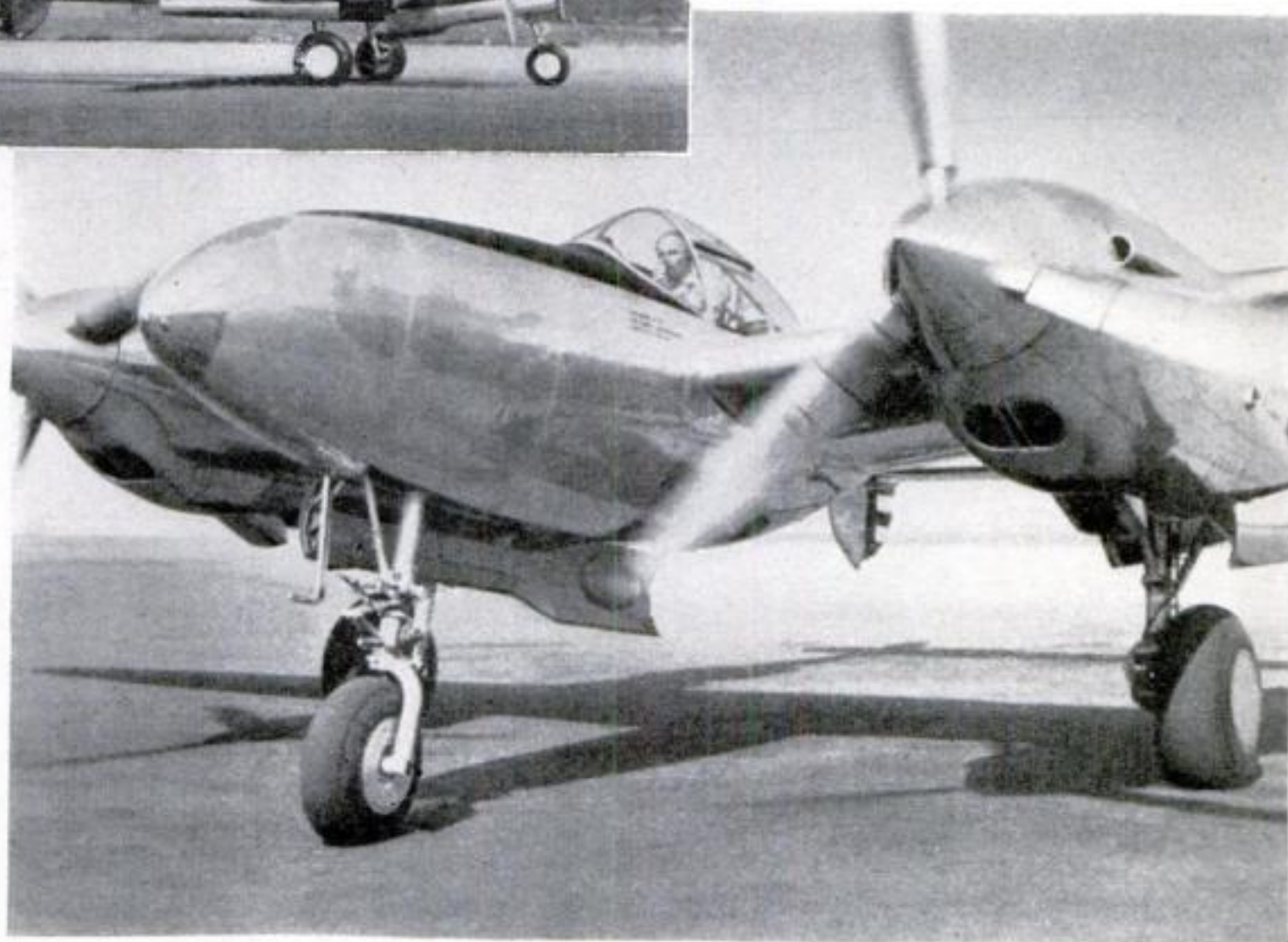
Net Gives Warning When Incendiary Bombs Land

STATIONING a watchman on top of a building to keep a lookout for incendiary bombs would be a risky business for the watchman, so St. Dunstan's store in London installed this warning net. It is suspended just beneath the ceiling of the top floor, and attached at the edges to a cord much like the signal cord running around the inside of a bus. This cord is hooked to a switch, seen at the right, above, which in turn is connected with a warning bell. If an incendiary bomb should penetrate the ceiling, it would yank the net and ring the bell.

Army Gets 500-Mile-an-Hour Plane



Two booms extending back from the engine nacelles carry the plane's tail surfaces and replace the usual fuselage



SEVEN hundred swift, fast-climbing interceptor-pursuit ships like the one above are now being built for the U. S. Army Air Corps. They are the new Lockheed P-38's, powered by twin twelve-cylinder, 1,150-horsepower liquid-cooled Allison engines and capable of more than 500 miles

an hour. The plane has a 52-foot wing spread, a tricycle landing gear, and multiple machine-gun armament. The ship is a development of the XP-38 flown by Capt. Benjamin S. Kelsey last year from Burbank, Calif., to New York in seven hours and forty-five minutes on part throttle.



NINE ARM BADGES RATE MARINE CORPS' ENLISTED MEN

OF THE NATION'S three armed forces—the Army, the Navy, and the Marines—the Marine Corps uses the fewest arm and collar insignia to indicate the ratings and specialties of their enlisted men. Compare the nine arm badges below with those of the Army and Navy illustrated in the December, 1940, and January, 1941, issues.



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GUNNERY
SERGEANT



STAFF
SERGEANT



PLATOON
SERGEANT



FIELD MUSIC
SERGEANT
SERGEANT
MESS SERGEANT
CHIEF COOK



FIELD MUSIC
CORPORAL
CORPORAL
MESS CORPORAL
FIELD COOK



FIELD MUSIC 1ST CLASS
PRIVATE 1ST CLASS
ASSISTANT COOK



A lesson in maintenance: recruits at Fort Benning, Ga., study a tank with its armor "unbuttoned"

How a Rookie Soldier Learns to Handle a Tank

The Civilian Becomes a Part of a World of Mobile Fighting Steel

By DAVID M. STEARNS

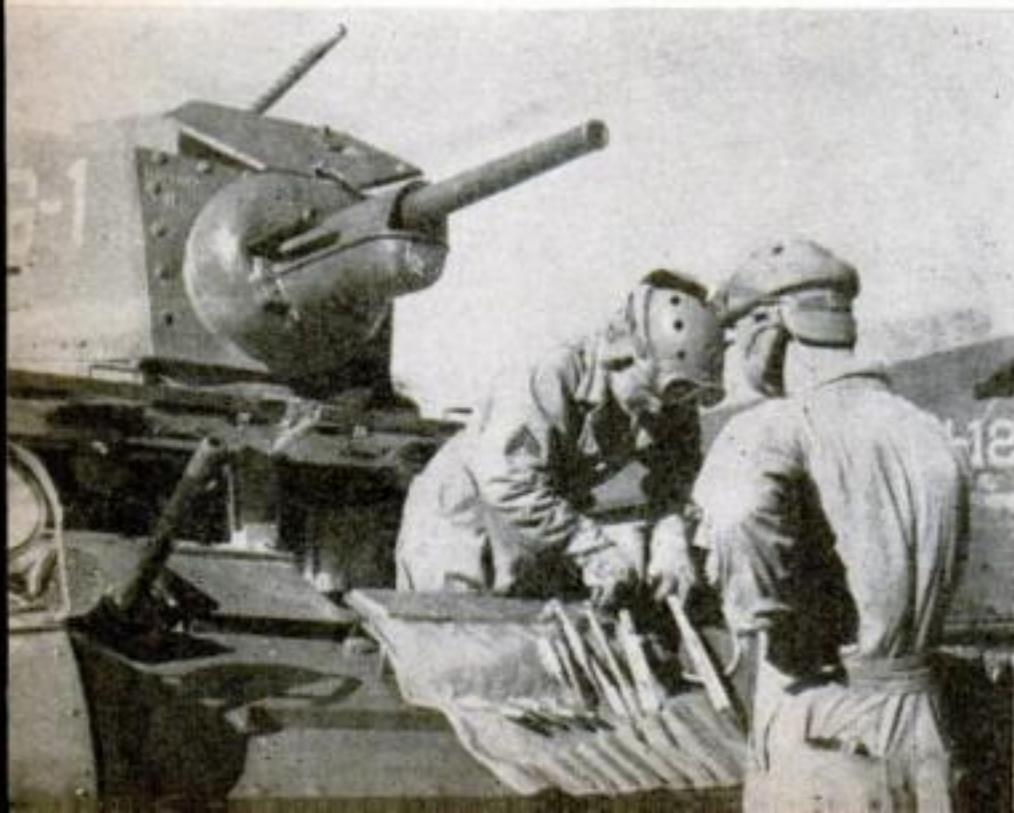
MASS-PRODUCTION education has been adopted by the Army to train rookies for the recently organized Armored Force. And it is working so well that graduates are pouring from the Armored Force School at Fort Knox, Ky., into the

service at the rate of 400 to 500 a week.

Because tanks are the backbone of the force, a large percentage of the graduates are "tankers." That means that they have completed a rigorous three-months course in which they were taught to drive and care for a tank, read maps, use and maintain rifles, machine guns, and 37-mm. or

Each day, before starting out, the driver must check his equipment, to the last hammer in the tool kit . . .

. . . and make sure that the tracks are at the proper tension. This is done by jumping on them, as below



75-mm. guns, the latter depending on whether they will be assigned to light tanks which are fitted with the 37-mm., or medium tanks which carry the 75's.

The Armored Force is proving highly popular with recruits, but soldiers with a yearning to become "hell-buggy" drivers have a good chance of getting what they want. By next June the Army will have four armored divisions, with 1,000 light and 400 medium tanks, plus ten reserve tank battalions of 54 light or medium tanks each. Since each member of a tank crew—four men in a light tank, five in a medium—must be able to fill almost any job in the tank, that leaves plenty of room for trained tankers. And the Army is already planning another six armored divisions.

There are no special requirements for tankers, though soldiers with mechanical ability and a good record in their general aptitude test are preferred. But a recruit has to satisfy his instructors in the course that he will make a tanker, or he is dropped.

Before a recruit even approaches a driving lesson, he has to learn the general characteristics of the type of tank to which he will be assigned. If it is an M2A4, the standard army light tank, weighing 11½ tons, he learns that it will make better than 50 miles per hour on a highway, and up to 30 cross-country, and that our army officers consider it the best little juggernaut of its kind in the world, superior to anything used by European armies.

If he is going to a medium-tank regiment, he gets an earful about the M2, a 20-ton job officially capable of 32 miles per hour on highways and up to 20 cross-country.

Then things come thick and fast. One day the budding tanker takes driving lessons. The next day he will work in classrooms, studying tracks, engines, transmissions, and other complicated parts.

The first steps in the driving are learned with the tank standing still, as even a light tank costs more than \$20,000, and the Army doesn't want to spoil any.

The student is plopped into the driver's seat on the left side of the tank. Under each hand he finds a "joy-stick," each with an electric trigger connected to fixed machine



Staff Sergeant Anthony Kasper of the 66th Armored Regiment with a speaking tube he devised from odds and ends for communication between the tank commander and driver



Hand signals direct drivers in maneuvering in close quarters. This one means to turn to the signaler's right . . .

. . . and this is the come-on: "Bring her a little ahead"



guns in the sides which are aimed by aiming the whole machine. The only familiar items will be the clutch and accelerator, which are like those in an automobile.

"Pull back on the right stick, and the tank will turn to the right," he is told. The left one will turn the tank to that side. Because the control sticks are attached to two brake bands in the transmission, each of which controls one track, pulling back on both at once will stop the tank.

It sounds easy until the student finds that to operate the gearshift lever, mounted on a huge six-speed transmission, he has to let go of one control stick. The transmission, incidentally, snuggles right alongside his right leg, and gets unpleasantly hot when the tank is under way.

Once he has mastered the theory with the tank at rest, he learns to operate the vehicle on smooth ground, first in low gear, later in higher gears and at higher speeds. The final phase is cross-country work, which means anything from bouncing over stone walls at 20 miles per hour to burrowing through ditches and shoving over three-inch trees. He must learn, for instance that if he doesn't "give her the gun," when his

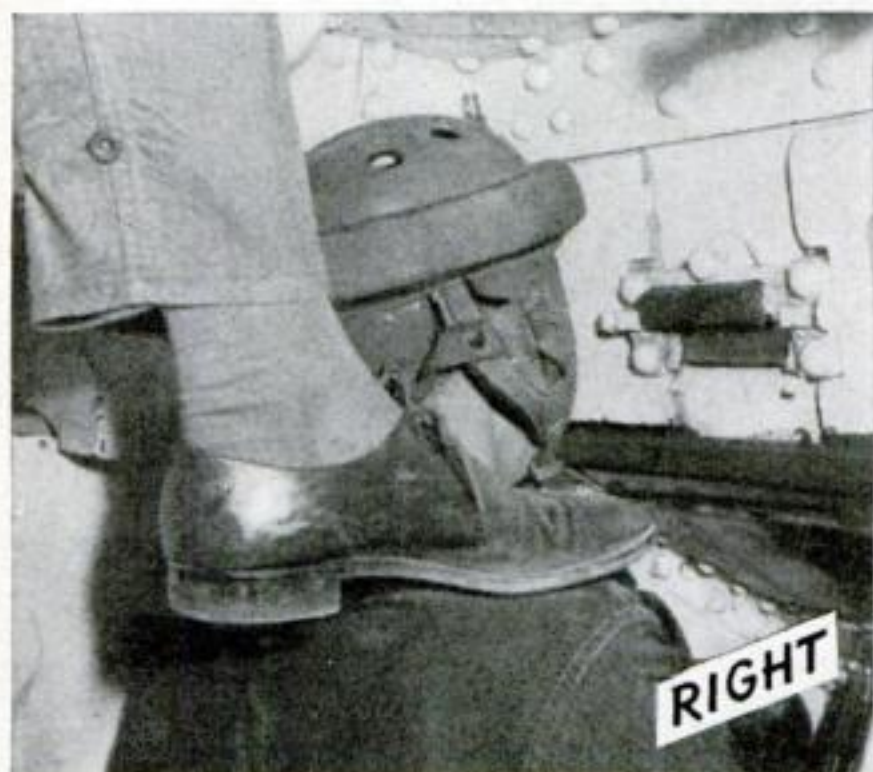
tank noses down a steep pitch, it may roll right over on its back.

All this has been done with the armor plate open in front of the driver, enabling him to see where he is going. Now he must learn to drive the tank when it is "buttoned up," with all the armor in place and his only means of looking out a narrow slit. He begins to develop sensitive shoulders, because the tank commander, who has slits on all sides of him and can therefore see all around even when the turret top is closed, directs the driver with the toe of his boot. This is necessary because the inside of a tank under way is noisier than the proverbial boiler factory, and even shouted commands are inaudible.

In tanks equipped with radios, such as platoon and company commanders', the assistant drivers must be radio operators as well as gunners and drivers. Recruits with an ear for code are trained for this duty after learning the other aspects of tanking. It is not an enviable position, because in action the operator must be able to tune his set and hear what is coming in, and send as well, with hot shell casings from the 37-mm. gun in the turret and the

Getting their "battle" orders: Before going into practice maneuvers, a platoon leader squats on a tank and tells his drivers what will be expected of them. Platoon leaders are usually lieutenants





Since voices are inaudible above the noise of a tank in action, the commander directs his driver by prodding with his foot in accordance with the simple code illustrated above. The driver's vision is limited to what he can see through a narrow slit. Below, a platoon of tanks drawn up in field formation on the furrowed Benning practice ground



machine gun beside his seat pouring down upon his head, possibly down his neck, if he forgot to button his collar.

To protect the tankers from bruises when the tank is bumping across-country, special crash helmets are provided, though even with them tankers have been knocked unconscious when the vehicle took a particular vicious bump at high speed. Khaki overalls are standard uniforms, and they rarely stay clean long. After each day's run, a tank crew must inspect their machine, re-

port any necessary repairs to the company commander, fuel and lubricate the buggy for the next day, and, if at a home station, clean the tank as well.

In the meantime, the tanker has been learning how to care for and make minor repairs to his tank and its power plant. He has studied the general theory of the four-cycle, internal-combustion engine;



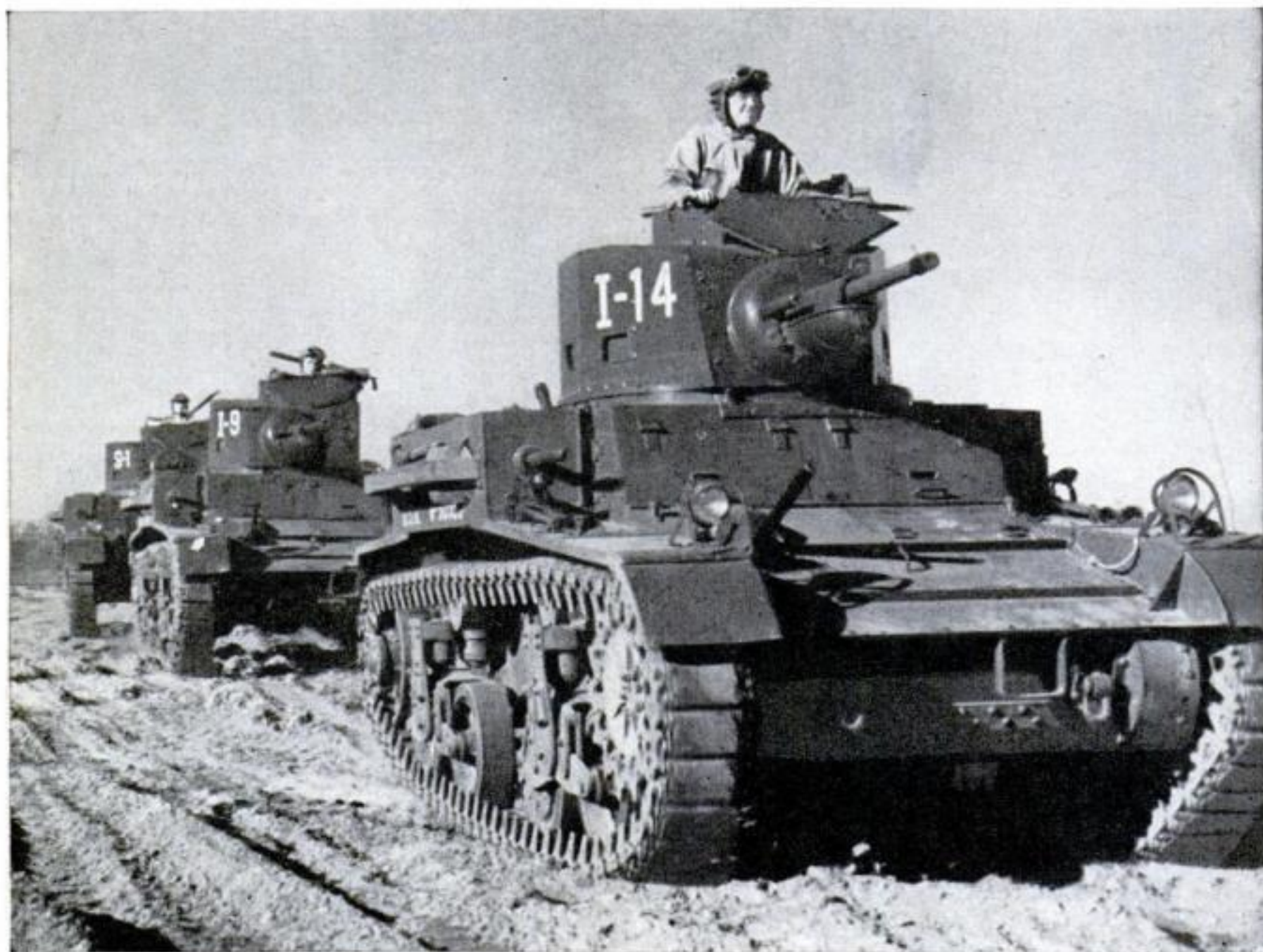
Respirator and goggles protect the commander from pebbles and dust...

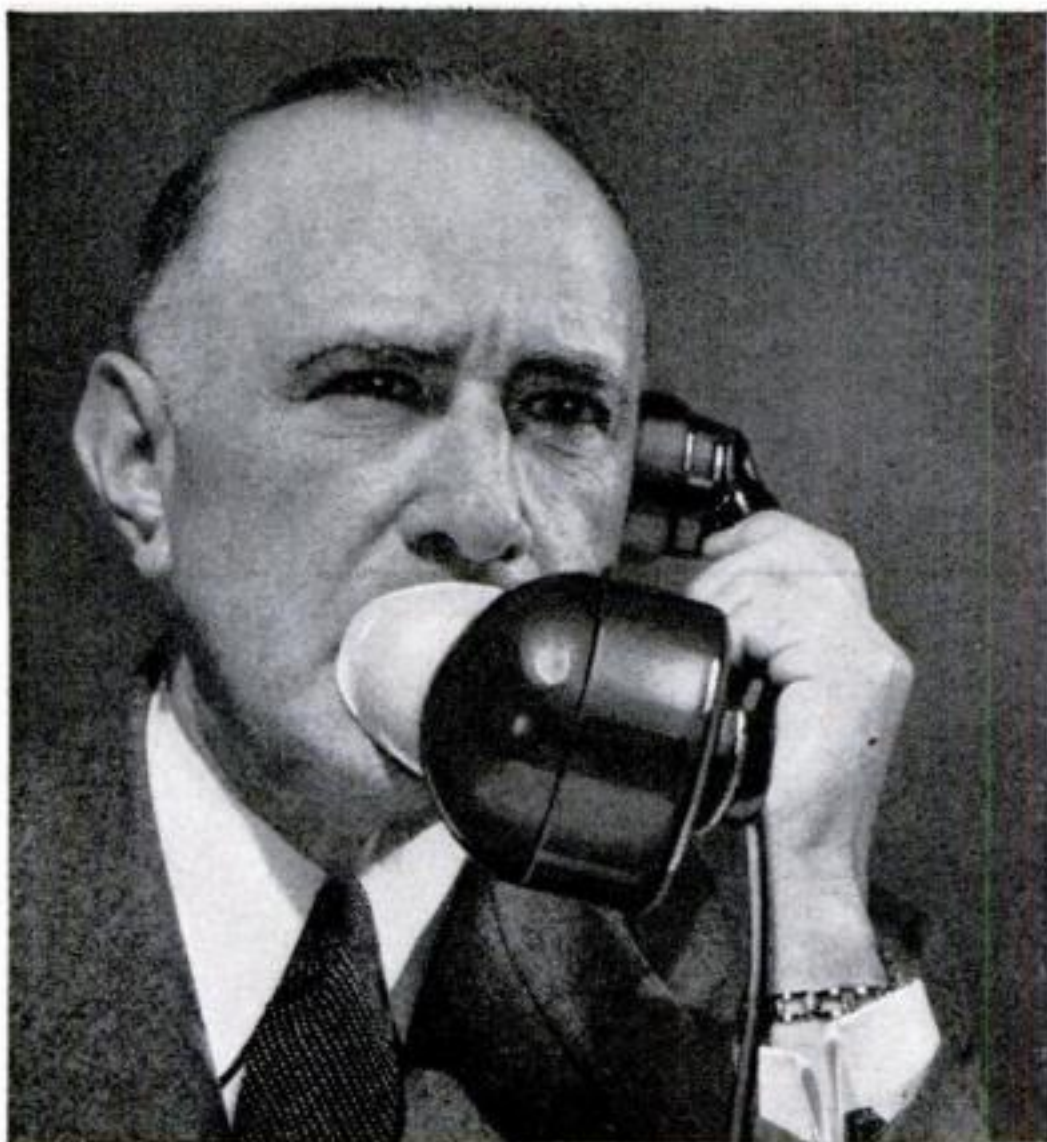
then he specialized in the type of engine which he will find in the regiment to which he will go after graduation. In the M2A4 this is either a seven-cylinder, radial, air-cooled 250-horsepower gasoline engine, or a Diesel of similar type and power. In the M2 it is a more powerful radial gas engine.

The end of the school course doesn't mean the end of his training for a tanker, however. After he is assigned to a regiment, there are cross-country marches, gunnery practice, and night maneuvers to keep his mind on his job.

For the more ambitious recruits who want quick promotion, there are study courses and examinations. And although a tanker probably won't find a job driving a tank when he returns to civilian life, it's a safe bet that he will be far wiser about the workings of gears and internal combustion engines. He may even find that he is a better automobile driver.

... when he rides with his head out to direct the driver. In combat, he ducks inside the turret.



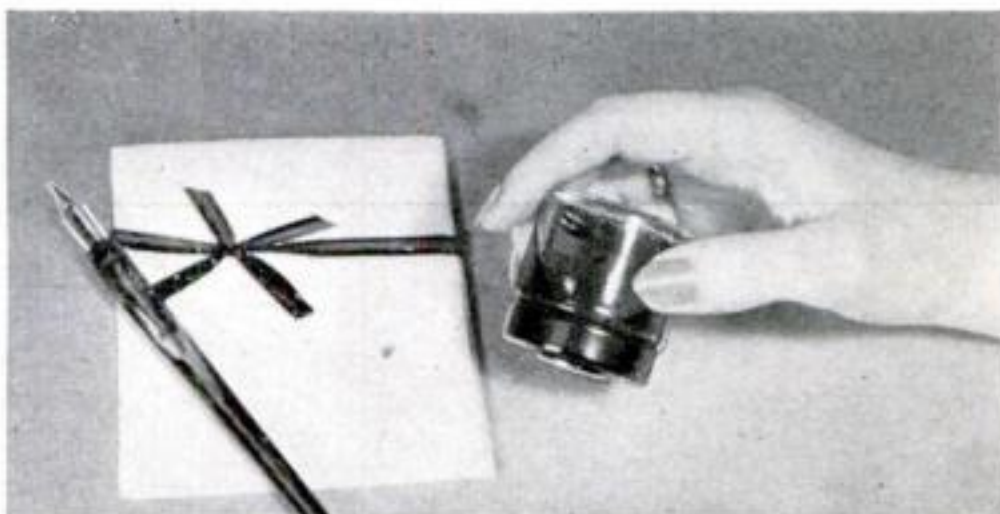


Every Phone Is a Booth with "Hush" Mouthpiece

PHONE-BOOTH privacy in the midst of a busy office is provided by an attachment which fits on the mouthpiece of any desk telephone. Molded of plastic, the mouthpiece is adjustable for position, and is lined with a sound-absorbing material which prevents words spoken into it from being heard more than a few feet away from the phone. It also absorbs room noises which would ordinarily be picked up by the transmitter and make it hard for a person on the other end of the line to hear clearly what was being said. The device does not interfere with ordinary use of the telephone, and is said to cut phone bills by making calls shorter.

Novel Bottle Eliminates Spots from Spilled Ink

IF CARELESS hands knock over the inkwell shown at the right, there's no harm done. A special inset made of small rubber closures makes it impossible for ink to spill out, even if the bottle is held upside down. A pen supplied with the spillproof inkwell has a ball point and will write 300 words between dips.



No ink spills out, even if the bottle is held upside down

Dictating Machine Uses Thin, Unbreakable Disks



Dictating machine and attachments. The carton at the right holds 100 disks with 50 hours of dictation

ALLOY disks seven inches in diameter and only .006 inch thick are used in a dictating machine which employs electric recording methods. Each side of a disk will hold 15 minutes of recording, and disks can be dropped, bent, or written upon without destroying the sound tracks. The unit includes a built-in loudspeaker for playing back

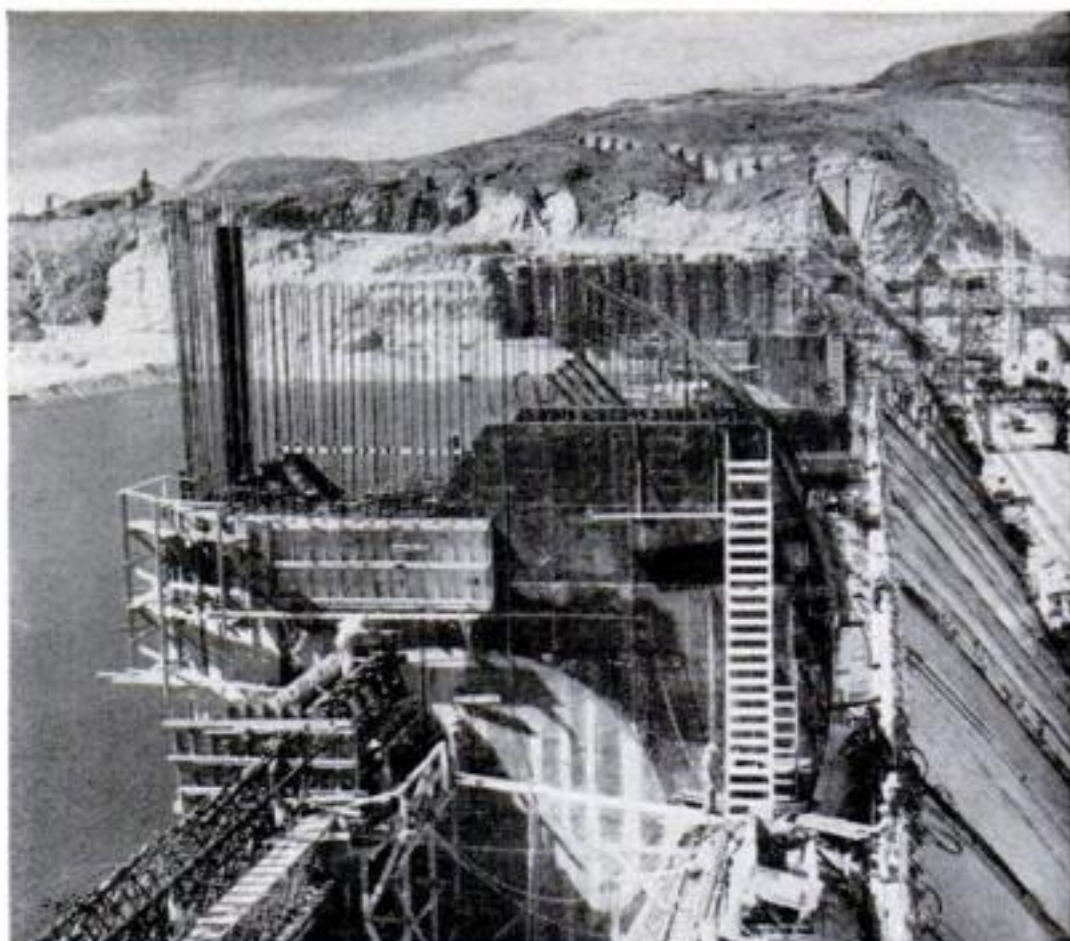
the records, and it may also be used with a "softspeaker," audible only at a secretary's ear for transcribing the records, or with headphones. The machine can be used to record entire conferences. Remote controls for hand or foot are provided.



Stray Electricity Used To Defrost Spillway Gates at Grand Coulee



Current passing through the cables shown here will heat the plates by setting up "eddy currents" in them



A view of the mammoth construction job at Grand Coulee Dam

A "DEFROSTING" method never tried before will prevent the 135-foot-long spillway gates of the Grand Coulee Dam in Washington from being stuck by ice. Standard submarine power cables are looped through holes in the reinforcement webbing of the cast-iron plates. Electric current passing through the cables sets up, by induction, "eddy currents" or stray electricity in the gate seats and abutments, keeping them warm. By generating the heat directly within the iron in contact with ice, maximum efficiency is assured. Nearly an acre of metal plates and more than nine miles of cable were used in the installation.

Transparent Motor Boat Made of Flexible Plastic Sheets

TRIALS of a transparent motor boat by its young builder, 17-year-old Richard Boerstler of Watertown, Mass., convince him that the craft is as practical as novel. Flexible plastic sheets, bent over framework of wood and aluminum and fastened with special cement, eliminate caulking and painting. The completed boat weighs only 43 pounds, and its $4\frac{1}{2}$ -horsepower outboard motor drives it at 25 miles an hour. The plastic hull offers the added advantage of resiliency in rough water. It can be carried on top of a car.



Richard W. Boerstler, 17, in his motor boat of transparent plastic sheets

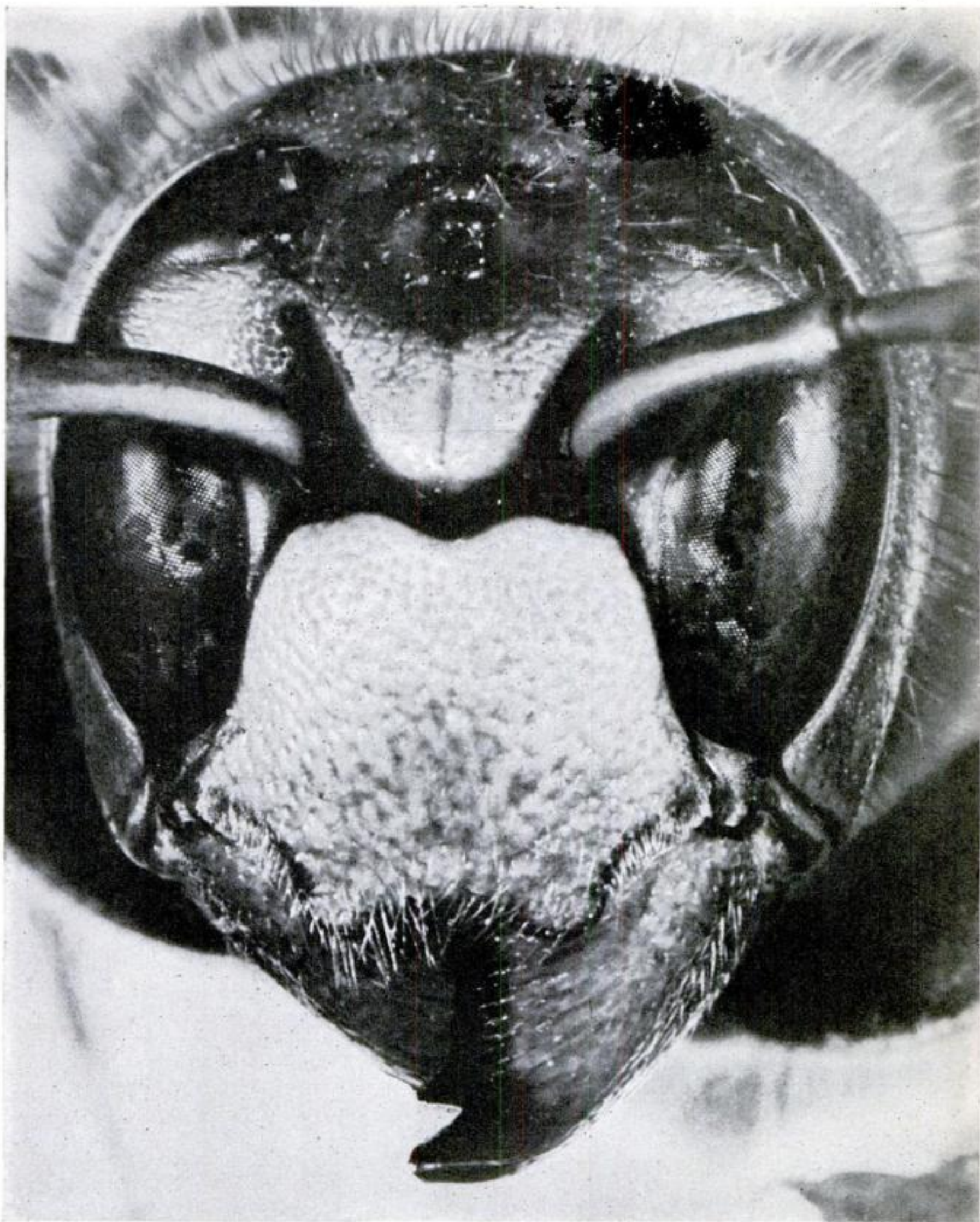


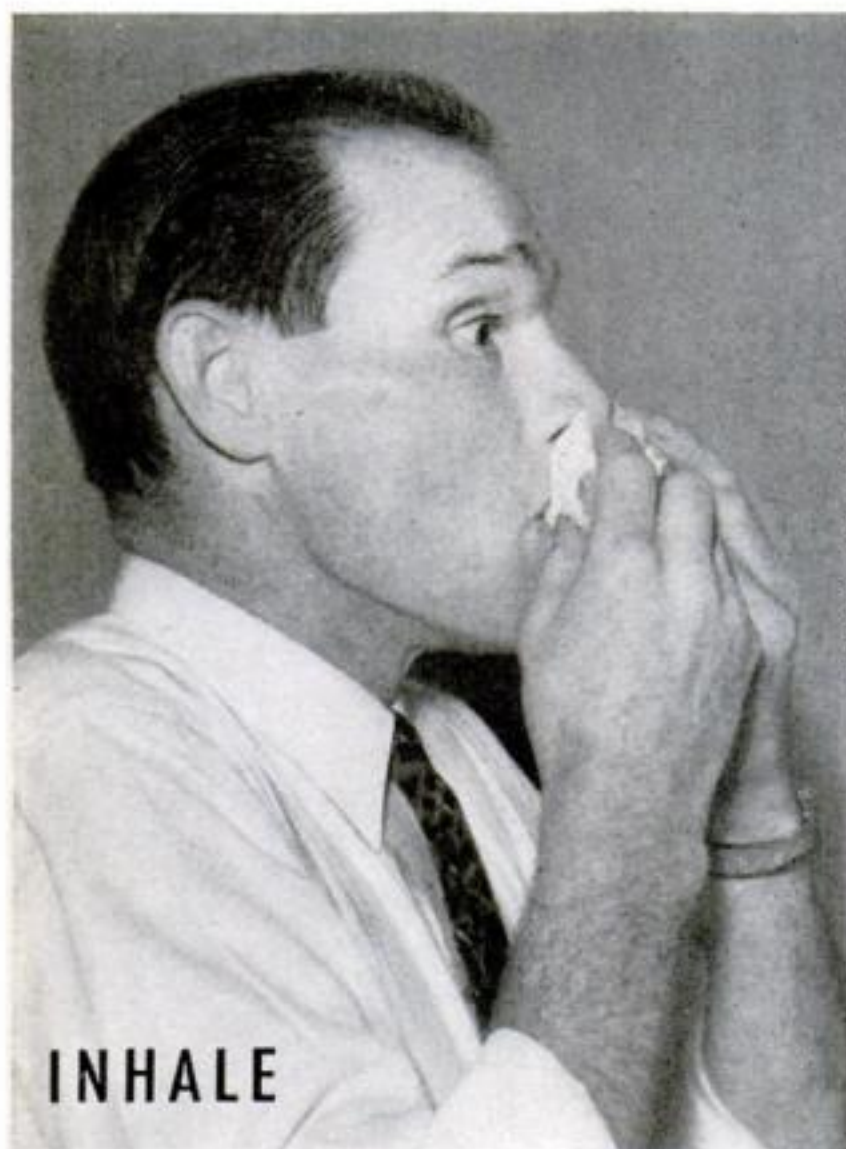
Photo Courtesy American Museum of Natural History

WHAT IS IT? No, it's not a "secret weapon" for frightening enemy pilots right out of their seats. It might well serve that purpose, however, because it does fly, and it does come from Europe. It's a close-up of the unshorn face of a European hornet. According to Webster, its scientific label is *Vespa crabro* and it is "very pugnacious." It was probably named hornet by our ancestors because the buzz of its wings reminded them of the sound of a horn.

The two feelers visible in the photograph have ball-and-socket joints so that they can turn in any direction; the jaws work sideways instead of up and down.

To obtain this remarkable shot, Charles H. Coles, chief photographer of the American Museum of Natural History, took his courage in both hands and made the photograph with a Zeiss planar lens, 100-millimeter focal length. Two baby spotlights were used to lighten the hornet's visage.

Taste Engineers



This man is not a hay-fever victim but a judge of cake. He depends on his sense of smell to judge whether the sample in his hands is up to standard

By **BERT ANDREWS**

WITH their taste buds and their sense of smell as their only tools, hundreds of skilled workers toil ceaselessly at an unusual trade so that consumers everywhere may be sure of the flavor and quality of products ranging from foods and beverages to cooking oils and medicines.

These adepts are taste engineers. They



Instead of simply tasting the cake, as a housewife would, this expert presses the piece to his nose and mouth and vigorously inhales its aroma

make their living by sipping, nibbling, or sniffing at tea and coffee, milk and cheese, baked goods and butter, candy bars and whisky, and a host of other edibles and potables.

They are more than mere *testers*. They are the bosses, in their respective fields, of the nation's dinner tables, its drinks, hot and cold, and its medicine chests.

If they say, "No, that's not up to standard," it means that the manufacturer is saved from much more costly rejection by the final judge—the public. Or, in the rare cases where the maker is deliberately trying to foist an inferior item on the buyers, it means that the proper authorities can slap him down.

The power that the taste engineers wield is founded on the fact—which seems odd to the uninformed in an age when so many believe that the test tube is all-powerful—that the human taste is a more accurate judge

TRY THESE TASTE TESTS

If you blindfold yourself and hold your nose, you can't tell the difference between coffee and tea, or between chocolate and vanilla ice cream, according to Washington Platt, of the Borden Company. Many kinds of candy lose their characteristic flavors. Rancid and fishy "tastes" disappear. But saltiness, being a true taste, can be distinguished.

of certain factors than is chemical analysis.

A case involving medicine illustrates this.

Not long ago the Government suspected that a medicine containing sandalwood oil was being adulterated with a cheaper ineffective oil extracted from a wood that was only a distant relation of sandalwood. The medicine was for use in certain venereal infections. Thus the false preparation was not only a fraud on the individual, since it deluded him into thinking he was using the proper medicine, but it was a menace to the public health.

Samples of the suspected medicine were brought in by investigators on the staff of William R. M. Wharton, chief of the eastern division of the Food and Drug Administration, in New York. They were subjected to chemical tests then available. The tests did not show the adulteration.

The taste engineers knew otherwise. Long experience with the taste and smell of the real potion made them certain that the suspected medicine was off standard, no matter what the laboratory analysis showed or failed to show.

Their certainty led to new research and to the development of a new method of analysis which added laboratory proof to the proof already obtained by nose and mouth.

Wharton's office had another case, concerning false claims as to the percentage of olive oil in a mixture of cottonseed oil and olive oil.

By chemical analysis, it is virtually impossible to differentiate, for example, between a mixture containing 15 percent of olive oil and one containing 25 percent.

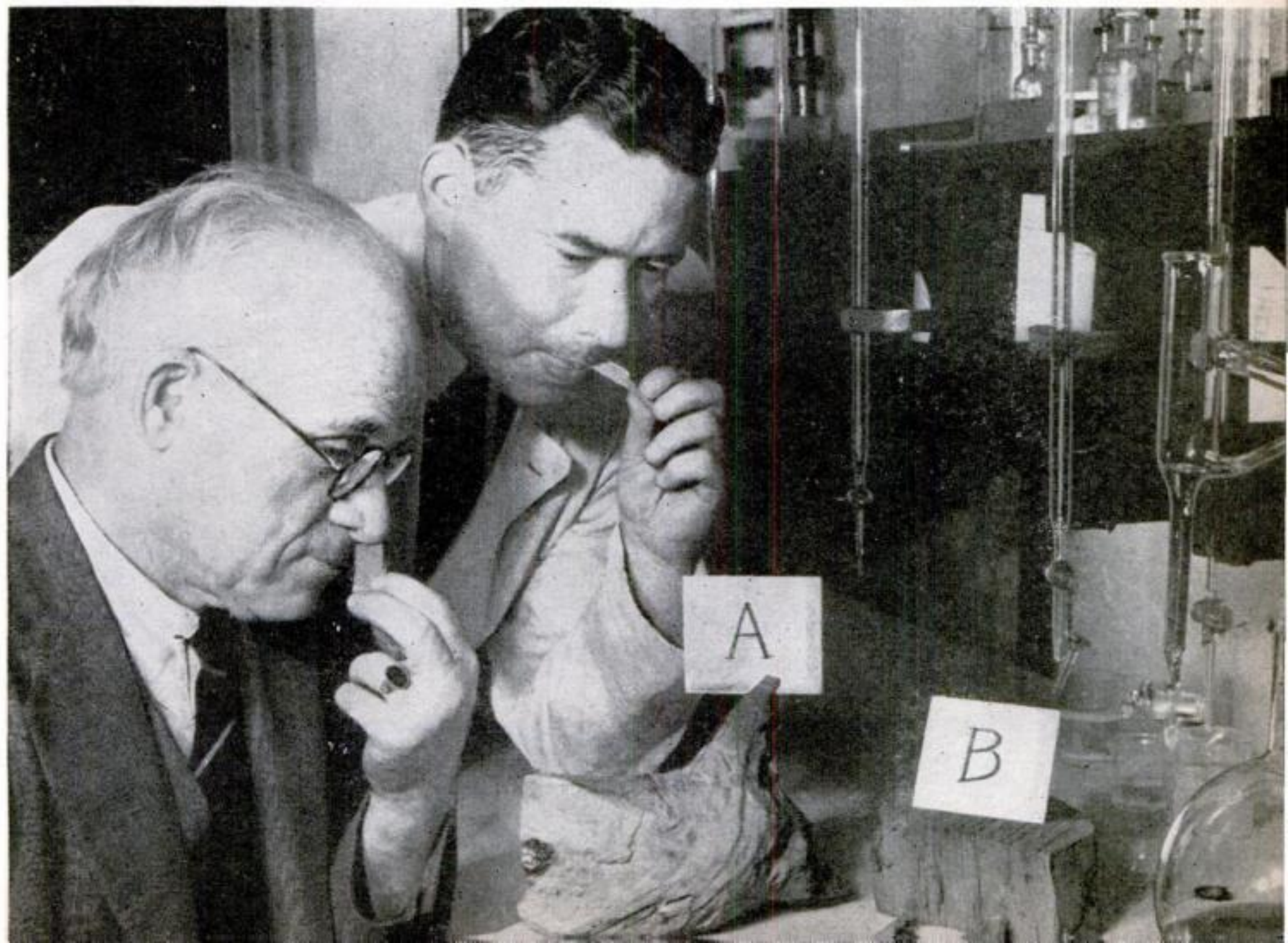
But the sense of taste cannot discern olive oil in such a mixture unless olive oil is present in the proportion of 20 percent or more. The manufacturer contended that 30 percent was present, but the taste engineer could not detect olive oil in the sample under suspicion.

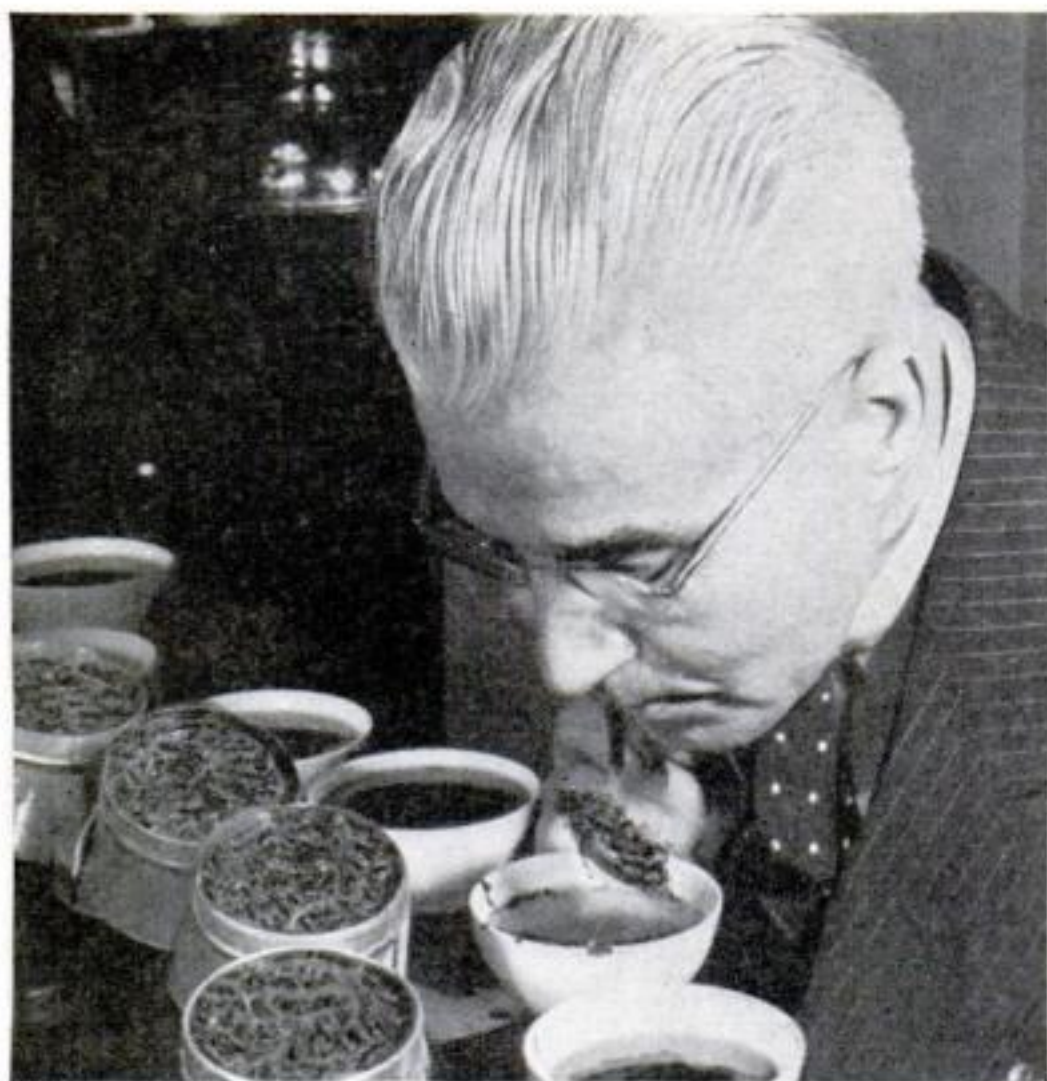
It is thanks to these men and women who carry their own laboratories around in their mouths that the thirsty can sip their favorite drink with the advance knowledge that it's going to be good.

Perhaps the best known example of scoring by taste is in the tea business. Each February, seven men selected by the Department of Agriculture as those with the most tea-sensitive palates in the land sit down at a five-day task of selecting samples of tea which will serve as the minimum standards for admittance into this country for the year beginning May 1.

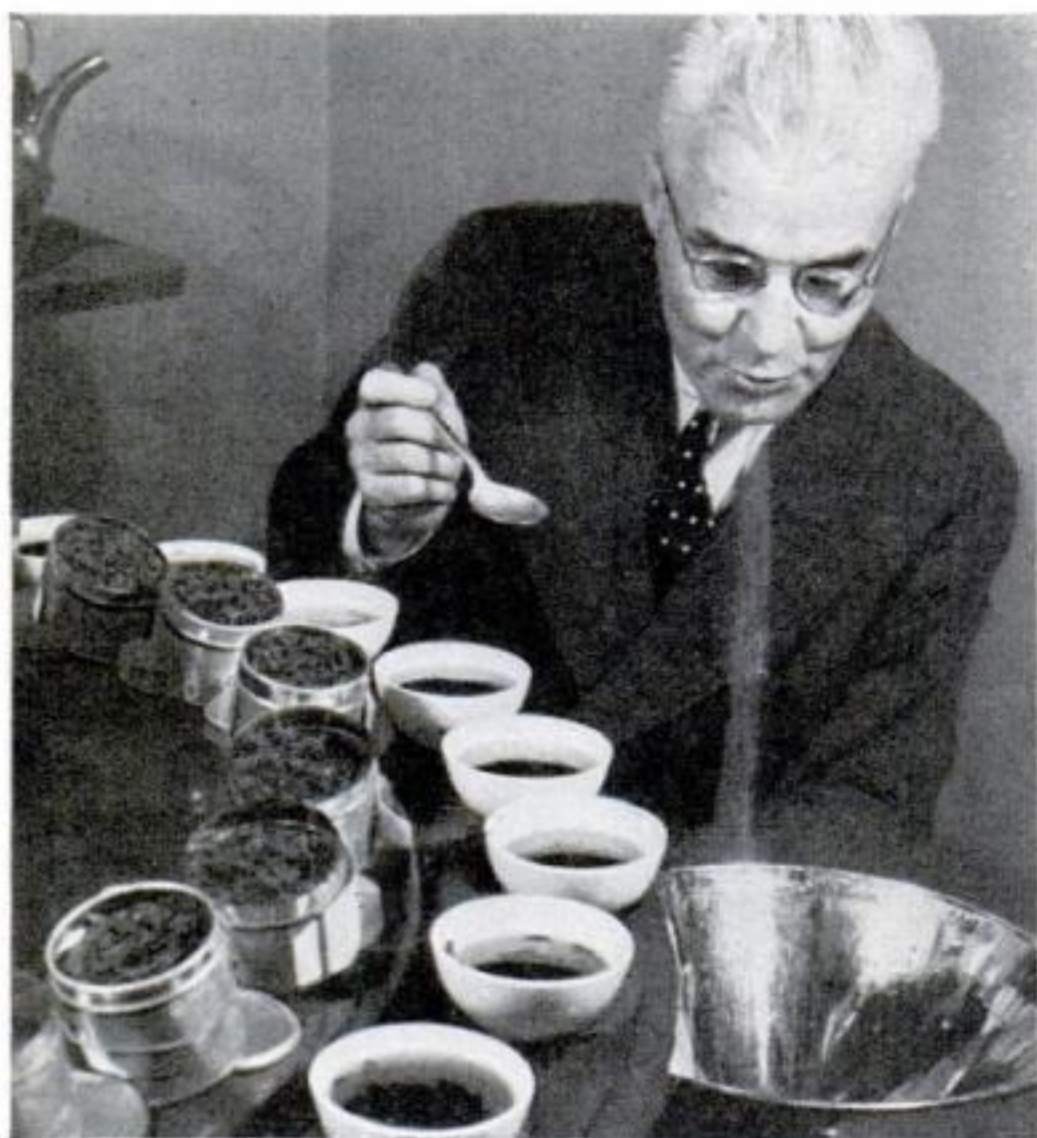
Tea drinkers might like to know that C. F. Hutchinson, in charge of tea inspec-

Distinguishing genuine sandalwood from spurious, by the taste and smell. The sample marked A is a substitute; B is real. Chemical tests proved nothing





C. F. Hutchinson, tea examiner, first inhales the aroma . . .



. . . then takes the sample in his mouth and spits it out

tion, prefers tea brewed exactly one minute. "Caffein starts to be released immediately," he explains. "It is two minutes before the tannin starts to be released. Therefore, at one minute one gets a mild, full-flavored tea."

Coffee tasters use three methods. A hand-

ful of the beans is held to the nose. Usually, even the faintest suggestion of contamination can be discovered by smell. If the sample passes this test, it is then roasted, a part of it is ground, and a small quantity placed in a cup. An infusion is made by adding boiling water. This steaming liquor is stirred by the tester while he holds his nose in the rising vapors. The "esters" of the flavor-bearing oils are conveyed by the vapors, and more about the flavor is learned.

The ultimate test is the "cup test." In this, the liquid remaining from the previous examination is rolled about in the mouth and then expelled. Disagreeable flavors or those denoting an unsound condition that may not have been previously discovered are then found.

Whisky blenders have their own taste problems. By experience, the blender knows the general direction in which he must travel to prepare a specified type of blend; that is, certain straight whiskies have characteristics adaptable for use in certain blends.

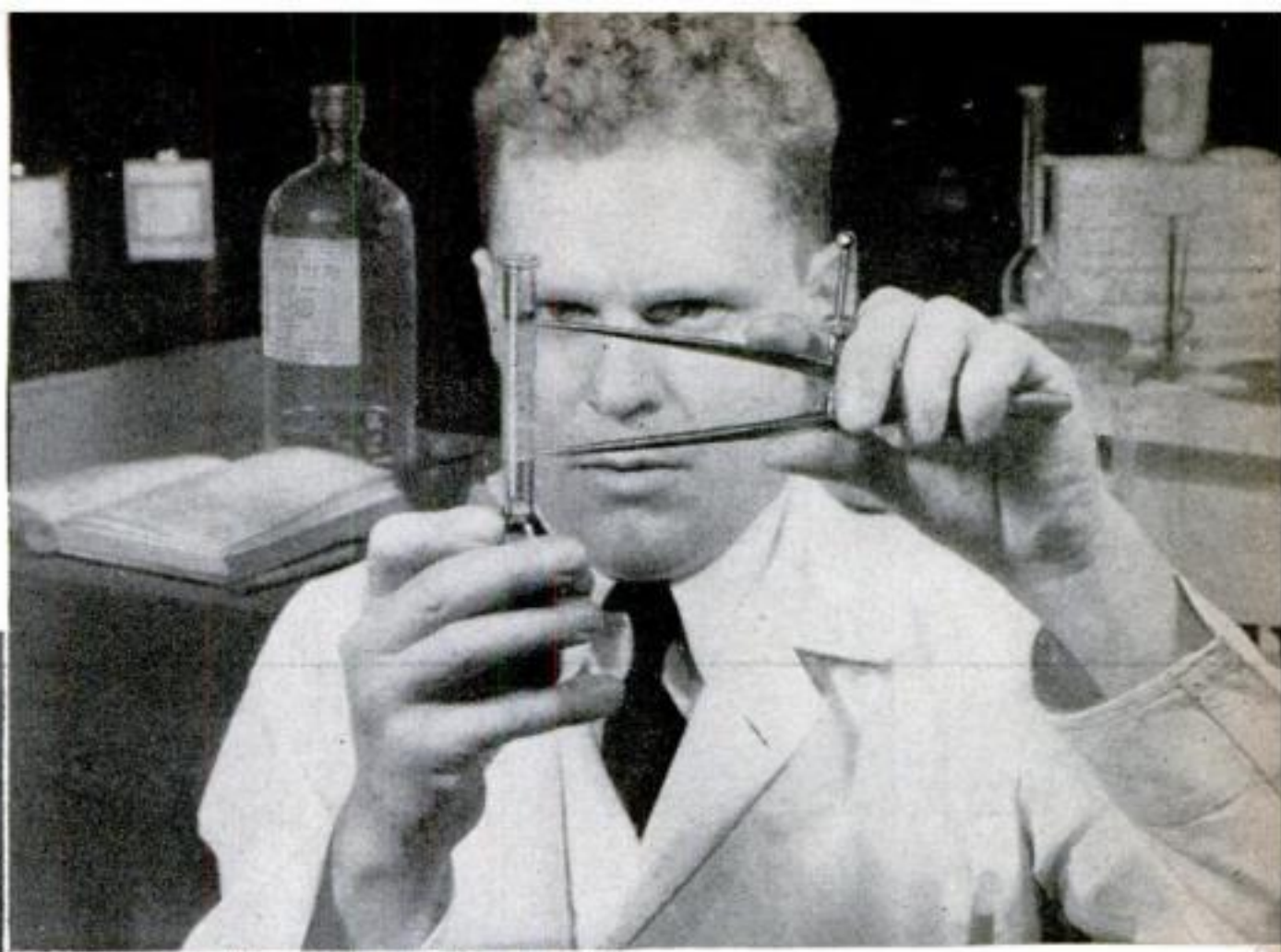
Twenty to thirty samples may be mixed, each using several straight whiskies in different proportions. Then a special board of taste engineers is appointed, usually consisting of the rectifying foreman, plant distillers, and others known to represent varying tastes. They stand around a table. Each of the trial blends is marked in code. Each taster votes for his preference by secret ballot, so that the opinion of a veteran may not influence a new member of the board.

To prevent jading of the taste each judge tries only a few samples. Although he does not swallow the samples, a certain amount is sure to be absorbed by the tongue.

The whisky industry has a favorite anecdote. Once, a cocksure individual boasted that he could distinguish any brand. He was

blindfolded and asked to sample twenty brands. He tasted nine in a row and named them correctly. He frowned over the tenth and put it aside. He went down the line with the remaining ten and named them correctly. He came back to the tenth, tasted it again and said: "I'm sorry, gentlemen, but

Reading the butter-fat content of milk from a sample treated with sulphuric acid to let the fat rise alone



Frank Baumert, of the Borden cheese warehouse, in New York, tastes each batch of incoming cheese. His grandmother, in the 1880's, made the first domestic camembert

that tastes just like Hillbilly Evan's corn liquor—out of his eighteen-month-old batch." He was right.

Tasters are almost always right, whether it's whisky or dairy products.

All fluid milk sold in cities and larger towns is tested before it reaches the consumer, either by tasting or by smelling or by a combination of both. Some of the off-flavors that the tasters look for are called rancid, tallowy, sweet-cloverish, burned (after pasteurization) and, of course, sour.

Milk producers remember that a cow in upper New York State ate an onion in 1927. The onion tainted her milk, and later tainted an entire carload of milk that was being sped to New York City for pasteurization and bottling. Since then, tasters have been fairly successful in their efforts to preserve in milk what is called a "bland," or almost "tasteless taste."

Cheese tasting is one of the most difficult lines in the taste-engineering profession. Weather—temperature, humidity, and rain-

fall—affects cheese. The product must be cured for a certain number of days or weeks, and this period must not vary by an hour. In many kinds of cheese, bacteria must be cultivated and allowed to grow, while other bacteria are rigidly excluded.

In spite of all this, the taste engineers can tell if a cheese is right, and if they pass it, the product is welcomed by the consumer.

Ice cream and cake go together, but the processes of tasting them are far apart. Ice cream has little odor, because the strength of odors is greatly diminished by cold.

With bread and cake, on the other hand, bakers judge flavor almost entirely by smell (and make some mighty funny faces doing it). Housewives and husbands have not learned that easier method, and so they have to taste bakery products.

But even if one had to go through life without seeing, smelling, or tasting his food, he could be sure of its quality. For the taste engineers stand guard.

Color Photos Guide Microbe Hunters



The wormlike creatures above are trichinae in pork



Careful staining brings out details of streptococci



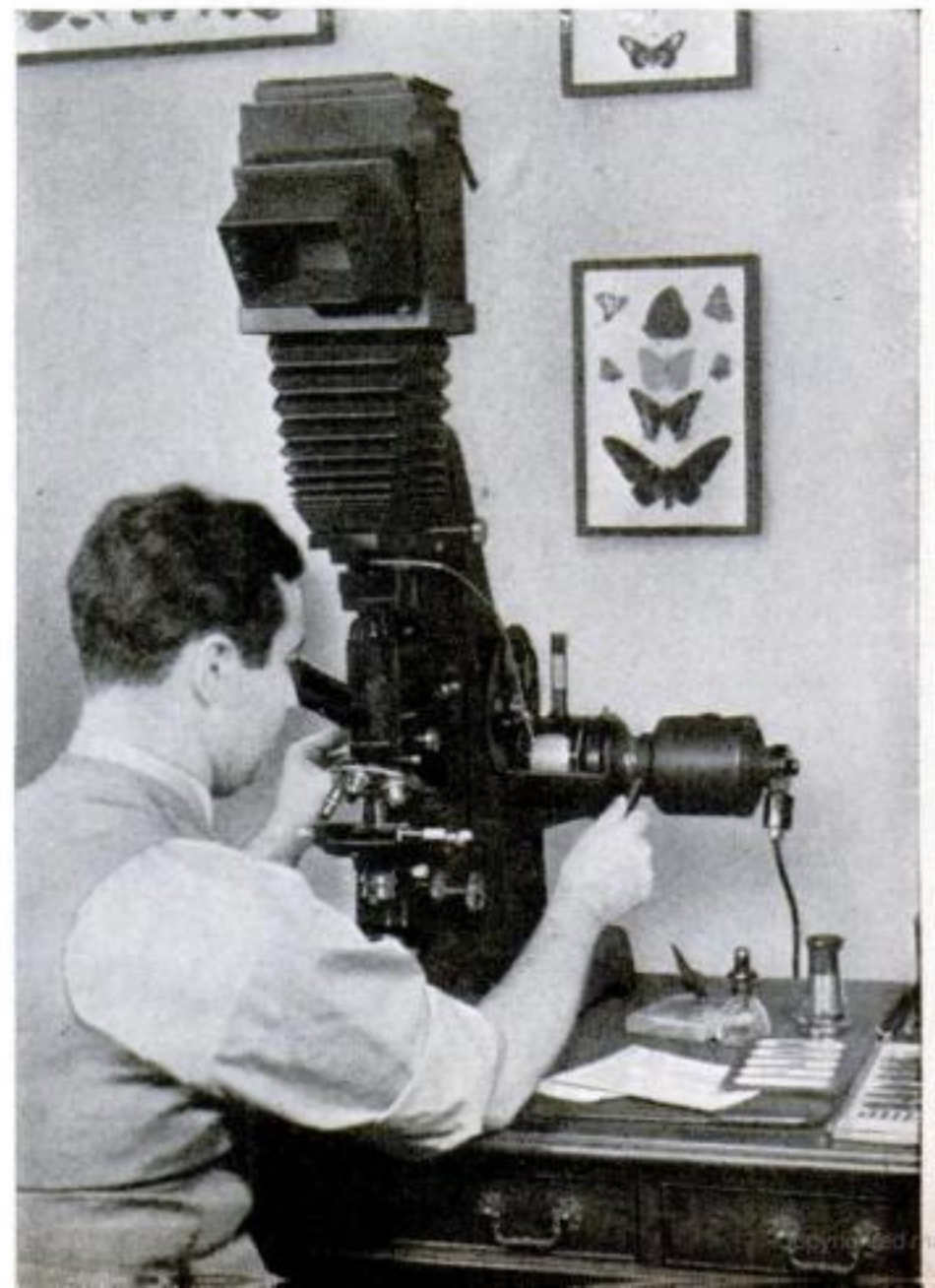
The human small intestine, as seen in cross section

PHOTOMICROGRAPHS of germs, nerves, tissues, and blood cells, recorded in full color and magnified as much as 3,000 times, now provide a valuable aid in medical diagnosis and teaching. In his pioneer work in this field, Julius Weber, photomicrographic expert at the Columbia Presbyterian Medical Center, in New York City, has taken more than 4,000 pictures on 35-millimeter Kodachrome.

The advantages of color in medical photomicrographs are obvious. Black-and-white pictures often record entirely different colors in exactly the same shade of gray. Again, when slight differences in hue are vital to diagnosis, they are readily apparent in color shots but impossible to detect in monochrome. A third advantage is that such films provide a simple means of showing students at medical schools exactly—color and all—what they will see when they look through a microscope at diseased cells and tissues.

In making magnified color pictures, Weber uses apparatus specially designed for the

In obtaining his full-color photomicrographs of bacteria, tissues, nerves, and blood cells, Julius Weber uses this camera-microscope



purpose. Features of his set-up include color-corrected lenses, perfect alignment of the optical parts to insure against light fringes, and illumination by a point-source filament bulb which is corrected to preserve color values in the picture.

Staining the specimens also is done with extreme care. If the staining is muddy or uneven, the resulting color transparency is correspondingly inferior. In his work, Weber employs between 100 and 200 different stains. Sometimes he combines them, using a number on one specimen to bring out different desired characteristics. A few delicate stains are fugitive, that is, they fade quickly when exposed to light. By photographing specimens immediately after they are stained with such chemicals, permanent records of the transitory colors are obtained.

In recording the photomicrographs shown on these pages, Weber used a number of stains. The red and blue dyes, haematoxylin and eosin, caused different parts of the trichina and the small-intestine pictures to stand out clearly. In the shot of the streptococcus germs, the "gram" stain for bacteria did the trick. The nerve cells from the human brain required silver nitrate and gold chloride. India ink injected into the blood vessels made possible the magnified view of the embryo chick.

By use of an electrically heated slide, kept constantly at body temperature, Weber has been able to record on color film the action of living blood cells. A thin layer of special dye on the slide gradually stains the cells. In this manner, the exact way in which white corpuscles destroy foreign bodies in the blood stream can be recorded.

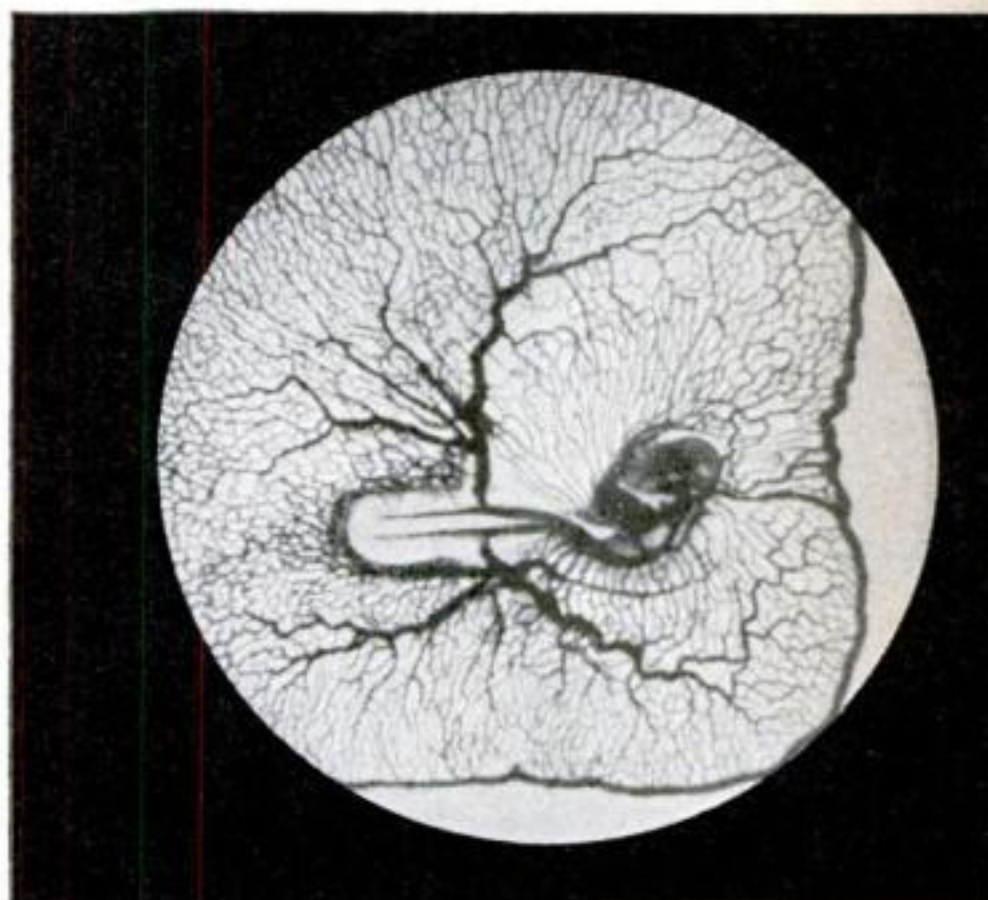
Ever since Weber was ten years old and his father gave him a small microscope for a present, he has been working and experimenting with magnifying lenses of many kinds. Shortly after he started work with color film, he discovered that the cover glasses placed over transparencies for their protection could prove a source of trouble. Treatment at the factory left a layer of chemicals on the glass that sometimes affected the emulsion or dye of the film. Ordinary rubbing fails to remove the chemical layer. So Weber makes it an invariable rule to scrub all cover glasses with soap and then rinse them thoroughly in running water before he uses them.

At present, Weber is engaged in a line of research of wide interest in dentistry. After impregnating dentine, the layer just under the enamel in teeth, with gold and silver stains, he makes magnified color pictures of small sections. The resulting transparencies, he hopes, will provide the final answer to the old question of whether or not there are nerves in dentine.

MARCH, 1941



Greatly magnified nerve cells from the human brain



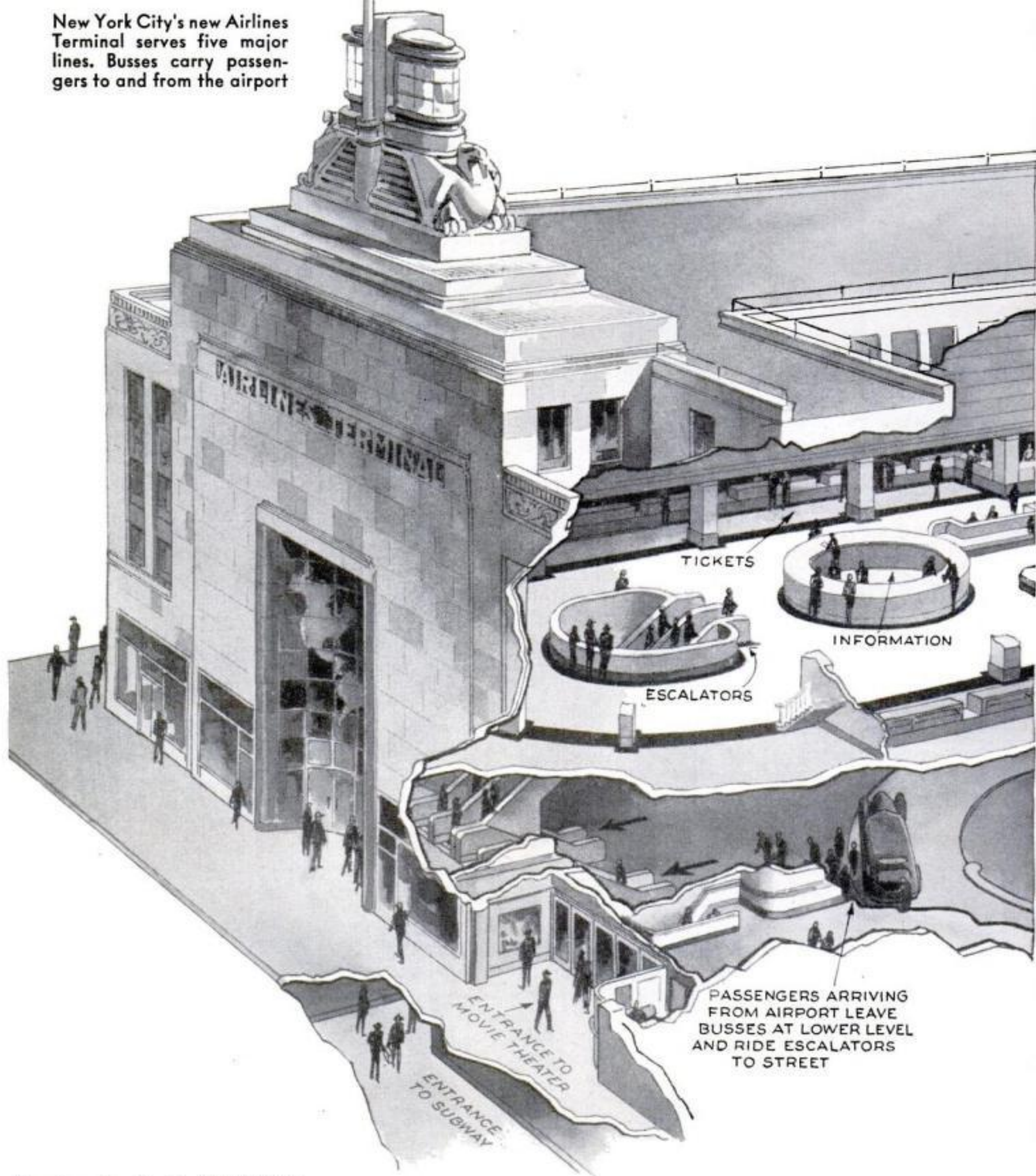
This is an embryo chick photographed by Weber

Weber staining a specimen in his laboratory at the Columbia Presbyterian Medical Center in New York. He employs more than 100 different kinds of stains



Grand Central Station of the Skyways

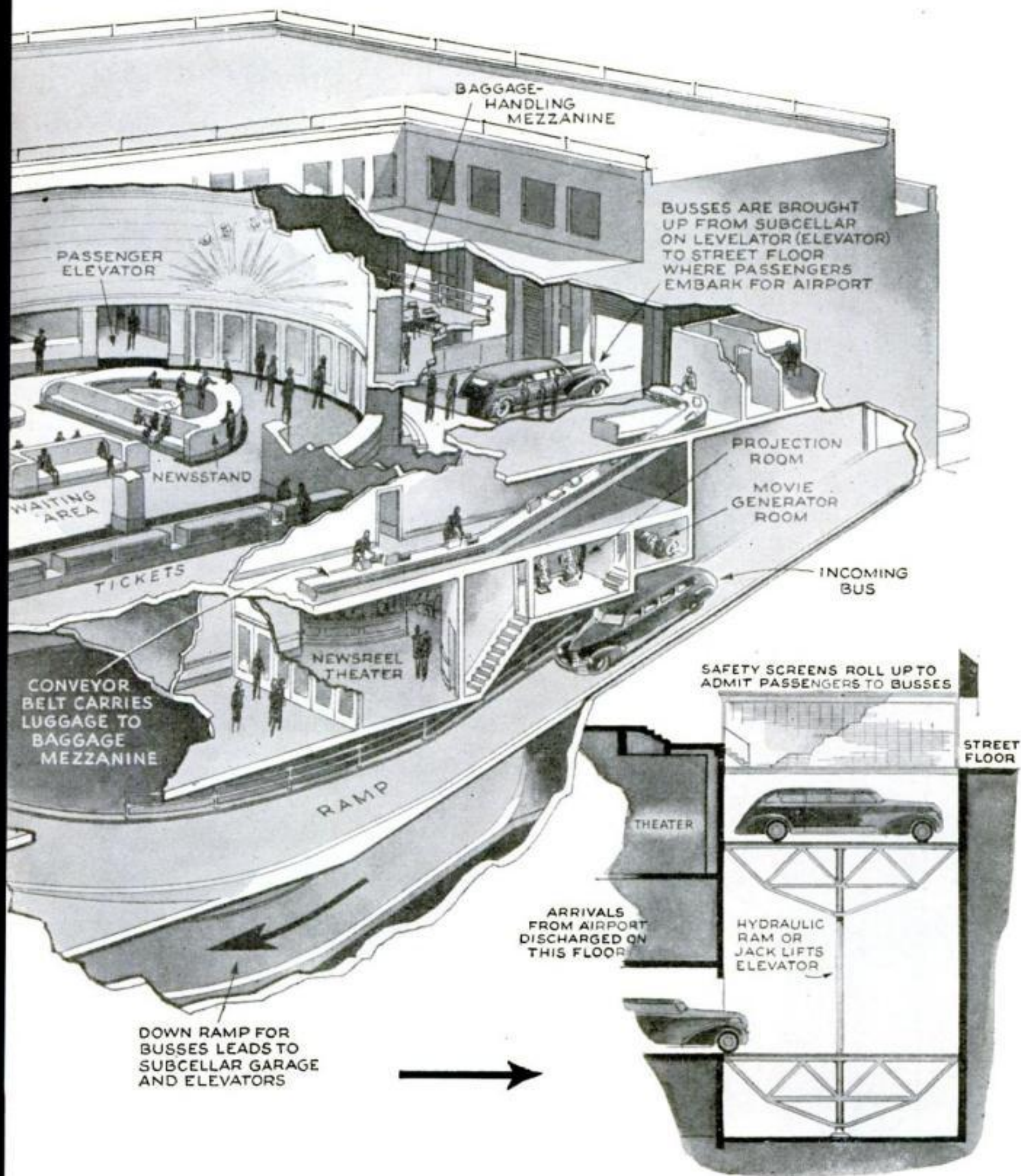
New York City's new Airlines Terminal serves five major lines. Busses carry passengers to and from the airport



Drawing by B. G. SEIELSTAD

TRAVELERS flying to and from New York may now pass through the first building of its kind in the world, the city's recently opened Airlines Terminal on 42nd Street opposite Grand Central Station. Although it is eight miles from the municipal airport, LaGuardia Field, the terminal was built and is operated by the five major airlines serving the city—United, T.W.A., American, Eastern, and Pan-American. Designed by

John B. Peterkin, the terminal was planned so that there would be no conflict between streams of arriving and departing passengers, who are handled on different levels of the building. They are carried to and from the airport in limousine busses, and the terminal has a capacity of 72 of these every hour. An independently operated motion-picture theater, showing short programs of newsreels, also has space in the building.

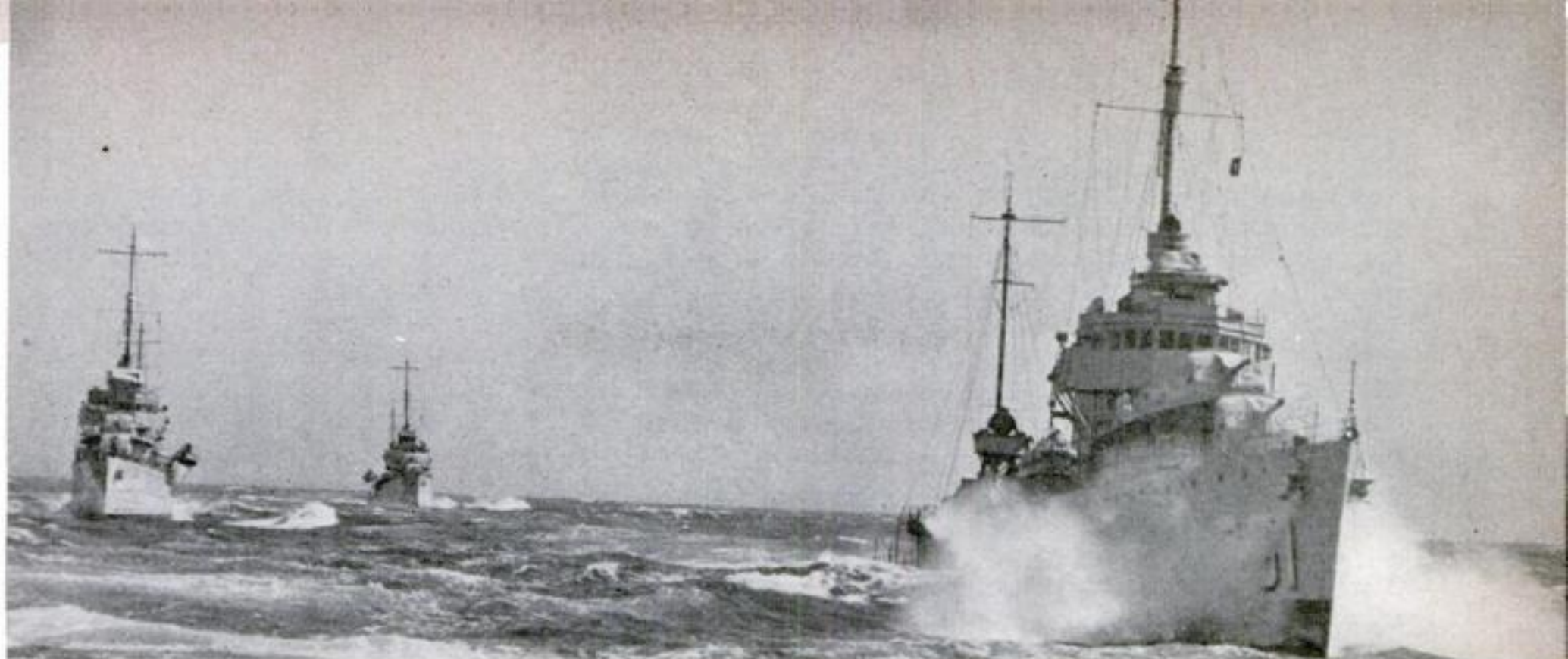




Giant Fire Truck Totes Rescue Gear

CARRYING EVERYTHING NEEDED FOR A RESCUE, a giant \$18,000, thirteen-ton truck is the newest piece of apparatus available to New York City's fire fighters. Among the hundreds of specially designed pieces of rescue equipment stowed inside the truck's thirty-one-foot body are the portable gasoline-driven smoke ejector, fire extinguishers, and Foamite mixer shown below and the smoke masks above.





Destroyer Hitting Power

*Fast and Formidable, the "Light Cavalry of the Sea"
Are the Most Versatile of All Modern Fighting Craft*

By JOHN E. LODGE

DESTROYERS of a new American type, classed as high-speed troop transports, have joined the fleet. In conjunction with landing maneuvers practiced by U. S. Marines in Caribbean waters, this winter, they are believed to have solved the problem of quelling a fifth-column uprising in Latin America.

In response to an appeal for aid, the vessels will race to a trouble spot, carrying picked, heavily armed Marine detachments. If hostile guns bar entrance to a harbor, the men will be prepared to ferry themselves ashore on any convenient beach, with armed landing boats of special design. Their duty will be to suppress the trouble makers, or hold them at bay until slower transport vessels arrive with reinforcements. War events abroad have proved the advantage of getting to places first, even if

it is with only a small body of crack troops.

Reconditioned destroyers in Atlantic service have been transformed into the first of the high-speed transports, by removing the deck-mounted torpedo tubes—superfluous except in naval battles—and rearranging eating and sleeping quarters to accommodate the extra men aboard. By experimenting with these converted ships, the Navy is standardizing their design, saving time and avoiding possibly costly errors in building an untried type.

Likewise, old but serviceable destroyers have been chosen to test other naval innovations. Several are being converted into our first anti-aircraft ships. Like a number of cruisers of the British fleet, which intro-

Commissioned last summer, the U. S. S. *Plunkett* is a specimen of Uncle Sam's new type of destroyers



duced the type, they will become floating nests of high-angle artillery, and will have the sole mission of shooting down air raiders. They are expected to mount three-inch guns for bringing down high flyers, and 1.1-inch rapid-fire guns of a recent design to deal with dive bombers. Besides serving with the battle fleet, such vessels would guard convoys of merchantmen against the new menace of air bombing.

More than a dozen converted destroyers will serve as mobile bases for the Navy's giant patrol-bombing planes. Soon after this country acquired the right to establish a naval base on the British-owned island of Bermuda, for example, the United States destroyer *George E. Badger* dropped anchor near Hamilton and began operating as a tender for the American flying boats. The incident illustrates how the whole chain of Atlantic outposts gained in our destroyers-for-bases deal with Britain can be used to our immediate advantage, pending completion of more permanent facilities.

These new duties supplement the varied ones that make a destroyer the most versatile of major fighting craft. In a naval

battle, destroyers conduct torpedo attacks upon enemy battleships; they "screen" their own against submarines, with depth charges, and against enemy destroyers, with shells. Their double-purpose guns can be elevated to extreme angles for use against aircraft. To hide offensive or defensive maneuvers, their funnels belch smoke screens. At night, their star shells illuminate enemy targets.

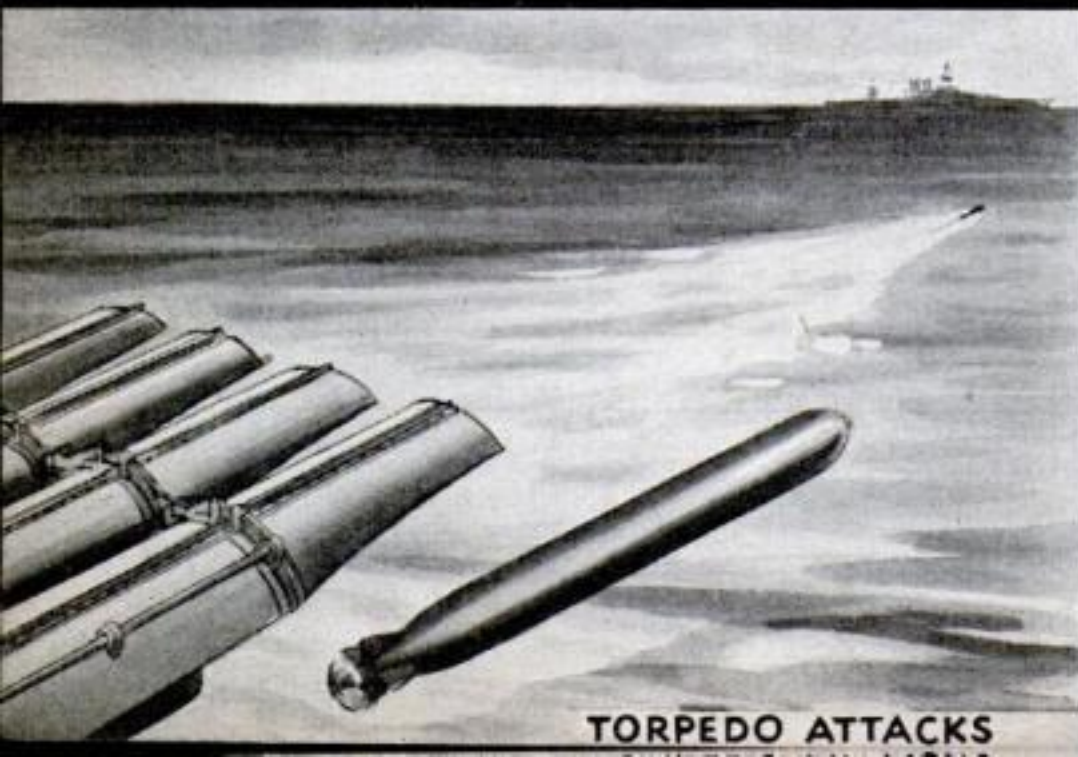
In addition, destroyers serve as fast mine-layers and minesweepers; escorts for convoys of cargo ships; submarine chasers on the high seas; and, within the limits of their cruising radius, commerce raiders. Destroyer crews of our own Neutrality Patrol, while under orders only to "observe and report" whatever goes on in American waters, have been obtaining first-class training for reconnaissance in war. Among other things, they have followed and ascertained the nationality of ships which would not signal their identity.

Only lightly armored, a destroyer can be sunk, according to the U. S. Coast Artillery, with an average of half a dozen six-inch shells that pierce its sides. The British destroyer *Gurkha*, attacked early in the cur-

DESTROYERS IN ACTION: SIX JOBS



SCREENING BATTLESHIPS



TORPEDO ATTACKS



LOCATING ENEMY SHIPS

rent war by German aircraft, was the first modern warship of its size to be sent to the bottom by air bombing.

Nevertheless, experts rate destroyers as second only to battleships in deciding the outcome of a sea engagement. Ton for ton, they are the most powerfully armed of any type of man-o'-war. To a modern fleet, they are indispensable.

By recently announcing the addition of 40 more destroyers to its already gigantic building program, the U. S. Navy emphasizes the value of these swift, hard-hitting craft. And a \$1,750,000 seagoing dry dock, to follow the fleet wherever it steams, is its answer to the question of what to do with destroyers seriously damaged in action, or in need of complete overhaul, far from established navy yards. The mobile base will service them at any lonely outpost—perhaps in the South Seas, in Alaska, or at one of the “stepping-stone” islands between Hawaii and the Orient.

A smaller floating dock of 393-foot length, the *ARD-1* was launched and commissioned in 1934 to try out the idea. It has been stationed at San Diego, Calif.

According to Rear Admiral Ben Moreell, head of the Navy's Bureau of Yards and Docks, “That was the first floating dry dock of this type that we ever built. One of those 1,500-ton destroyers is the largest it will take, and even with those you can't pull a shaft in it. It will not take a destroyer leader or a large-sized submarine. It was an experimental structure, and it has been so successful and the fleet is so pleased with it that we want to go ahead and build this larger dry dock. It will take the largest new-type submarine or destroyer leader, and you can pull a shaft on that destroyer leader.” Impressed by the Admiral's words, Congress voted funds for the novel dry dock last June.

According to latest figures, this country leads the world in the number of destroyers built and building, with a total of 365. Next in order come the British Empire, 240; Japan, 146; Italy, 132; Russia, 83; France, 80; Germany, 47. Because of wartime secrecy, some of these totals necessarily are estimates, based on the best unofficial information.

As for destroyers completed at this writ-

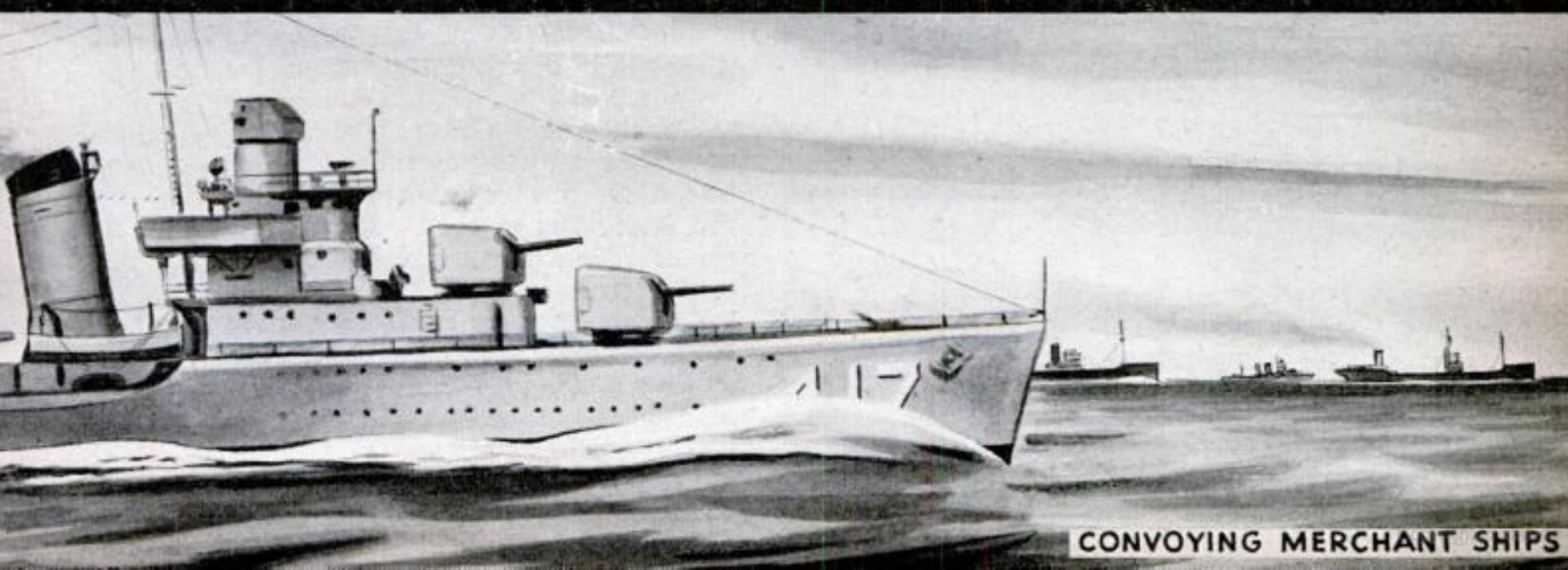
THEY PERFORM IN WARFARE AT SEA



LAYING SMOKE SCREENS

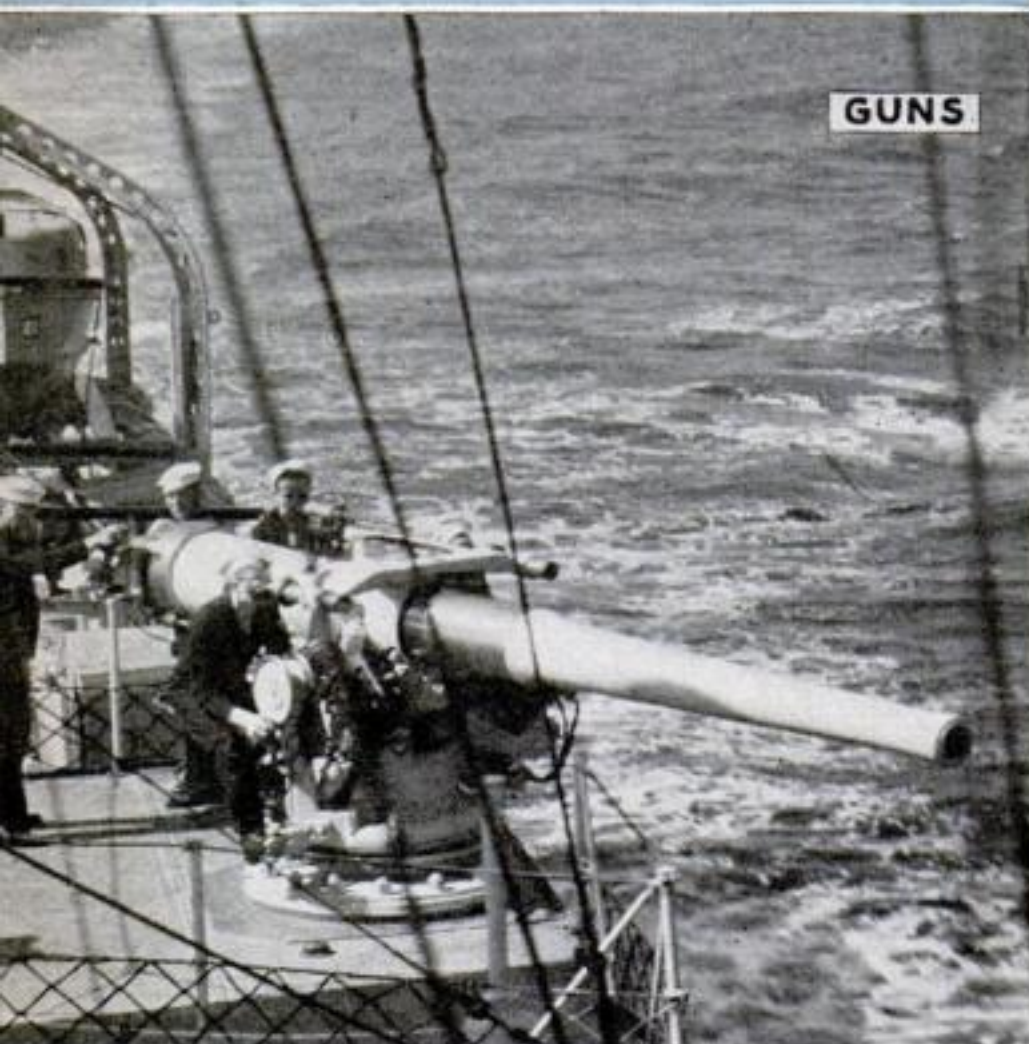


BATTLING ENEMY DESTROYERS

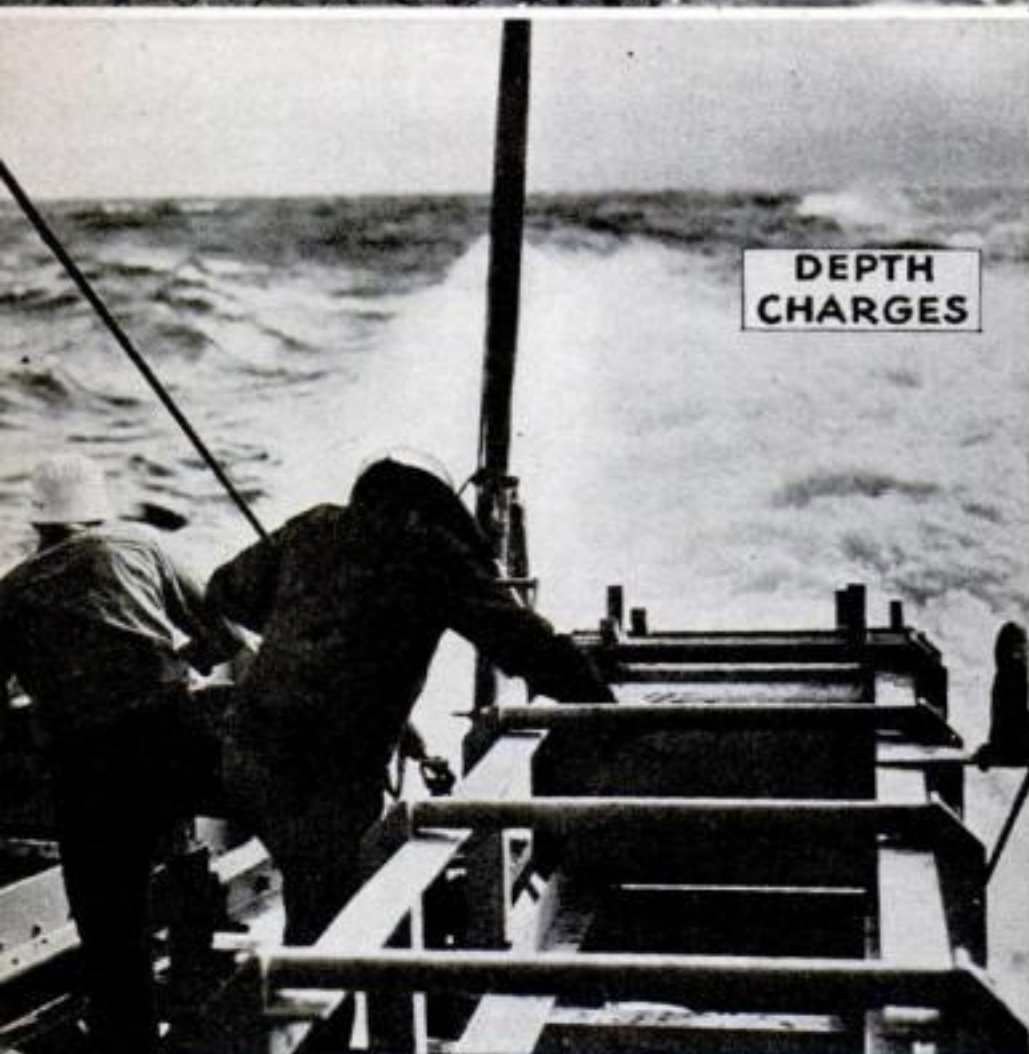


CONVOYING MERCHANT SHIPS

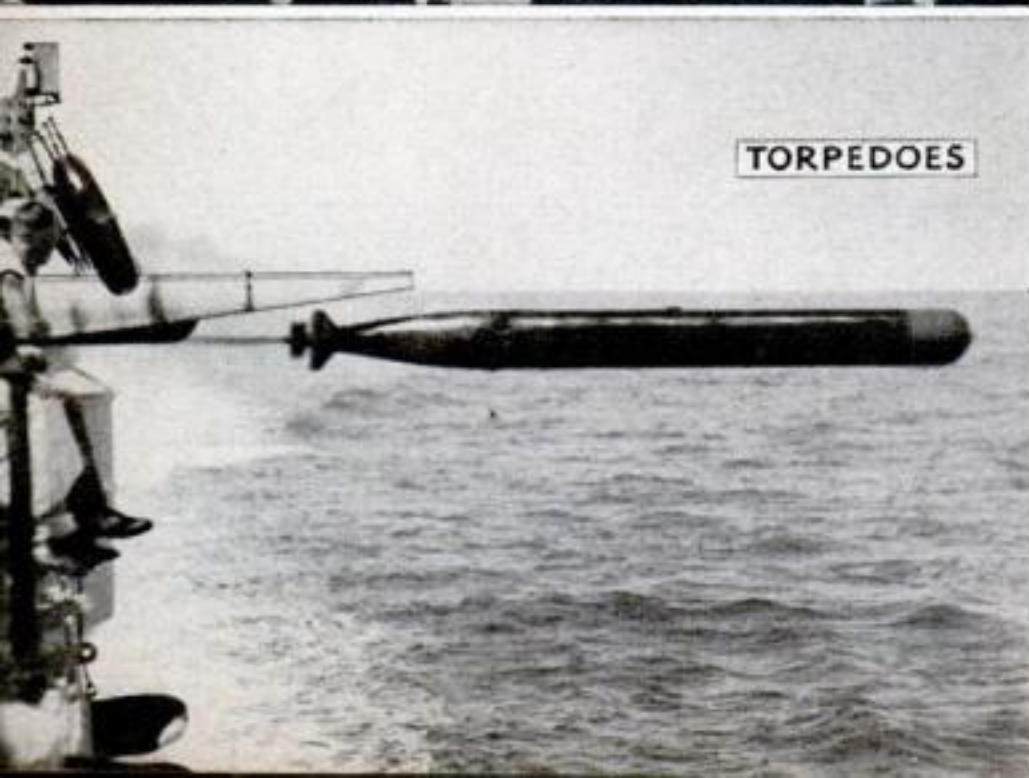
A Destroyer's Weapons



GUNS



DEPTH CHARGES



TORPEDOES

ing, the British Empire trades places with us at the head of the list, and the other powers follow us in the same order. With 135 destroyers afloat, Japan comes uncomfortably close to our 155 ships of the type, especially in view of the comparatively large proportion of over-age, reconditioned American destroyers. Perhaps because of this situation, the U. S. Navy has just given its construction program a shake-up. Contracts for a number of destroyers and cruisers have been redistributed so that each shipbuilder, to the greatest possible extent, will concentrate on turning out a single type of standardized design. Experience gained in constructing one vessel will thus help to speed up work on the next. As a result, naval men expect to swell the total of warships that we are currently producing at the rate of one every twelve days.

Today a typical American destroyer of 1,500 to 1,700 tons carries up to six five-inch guns, and from eight to sixteen torpedo tubes. "Heavy destroyers," a 1,850-ton type of destroyer leaders, mount two more guns. The two classes are expected to merge into one, in destroyers still to be laid down.

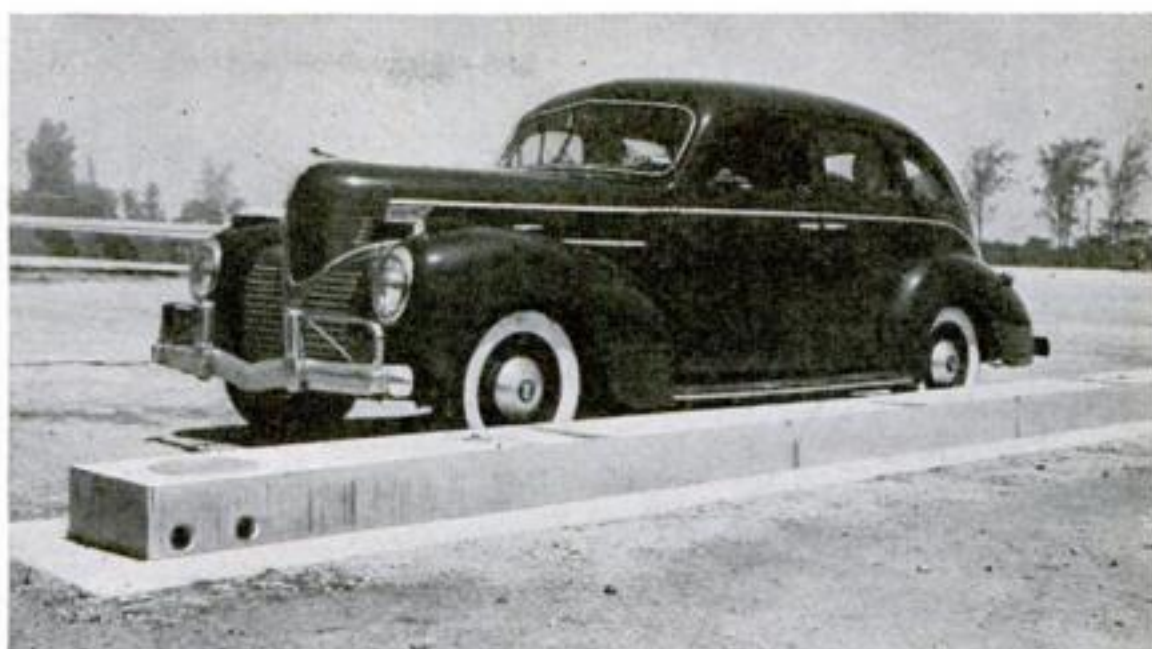
No place for a comfort-loving landlubber, a destroyer bucking a heavy sea may roll as far as 45 degrees from the vertical, and crews dine on sandwiches when the cook's pots begin sliding about. The slim hull virtually is built around the throbbing power plant of 50,000 horsepower, which propels the latest type of American craft at 40 knots or more than 45 land miles an hour. From full speed astern, at half this pace, the ship can leap to full speed ahead in exactly one minute and five seconds.

Its boilers, pride of the Navy's engineers, feed steam to the turbines at the extreme pressure and temperature of 600 pounds to the square inch, and 850 degrees. Darken the interior, and the pipes carrying the superheated steam will be seen glowing red. Success of the innovation on the destroyer *Somers*, late in 1937, has led to its adoption for all new battleships, cruisers, and destroyers. But its use in destroyers has by far the greatest significance. Tests show a fuel saving for these craft of 14 percent—which means that with the same amount of oil, they can cruise proportionately farther.

To grasp what that means, consider that the whole fleet's radius of action depends upon the cruising range of its destroyers. These essential craft are the ones that tie the Navy to its bases, for battleships and cruisers can travel many times farther before refueling. With the new boiler installations, destroyers can steam 2,500 miles or more from a base and return, extending the mighty power of our fleet farther than ever before.

Retractable Curbs Adapt Roadway for Rush-Hour Traffic

RETRACTABLE curbs are being tested as a possible solution to Chicago's rush-hour traffic problem. Installed in the city's Lincoln Park express highway, three lines of concrete-and-iron dividing strips make it possible to separate the eight-lane roadway into various combinations of two, four, and six-lane units. The road is only 100 feet wide, 70 feet less than the width of an ordinary highway designed to handle the same traffic volume. The curbs, built in 25-foot lengths, are lifted eight inches above the road surface by electric pumps and hydraulic jacks which work automatically after a control switch is thrown. Lights inside the curbs, showing through holes in the sides, outline the strips at night. Powerful springs haul the curbs back to road level when the pumps are turned off. In wartime the curbs could be used to separate military and civilian traffic, and, with the curbs retracted, the road could be used as an airplane runway.



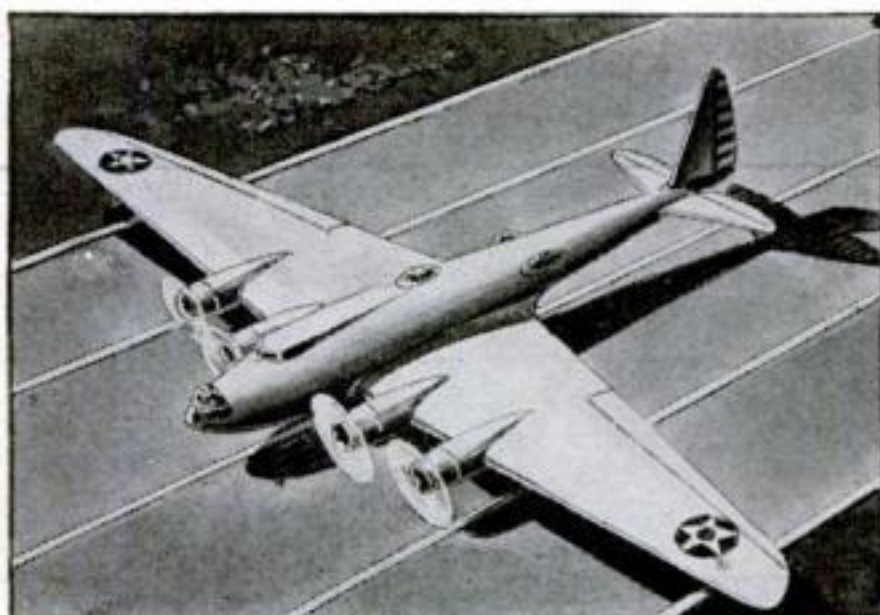
A "disappearing" curb on Chicago's Lincoln Park express highway. The 25-foot sections are raised or lowered to divide the road as required



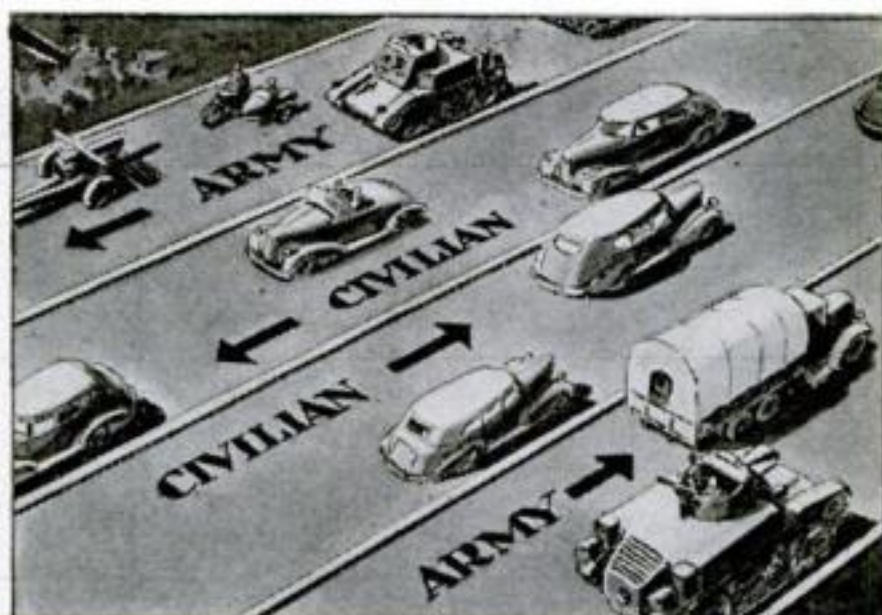
For rush-hour traffic: six lanes in one direction, two in the other



For normal traffic, the roadway is divided into two four-lane strips



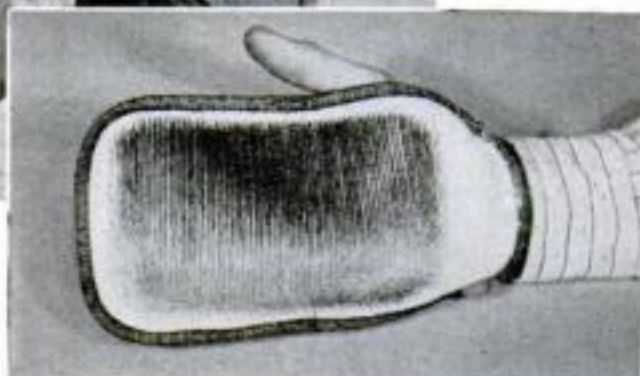
In wartime, with curbs retracted, the 100-foot boulevard could serve as an airplane runway . . .



. . . or it could be divided to separate civilian and military traffic, speeding troop movements



Dressing a dog's coat with the wire-bristle mitt. Corduroy on the back imparts a final shine

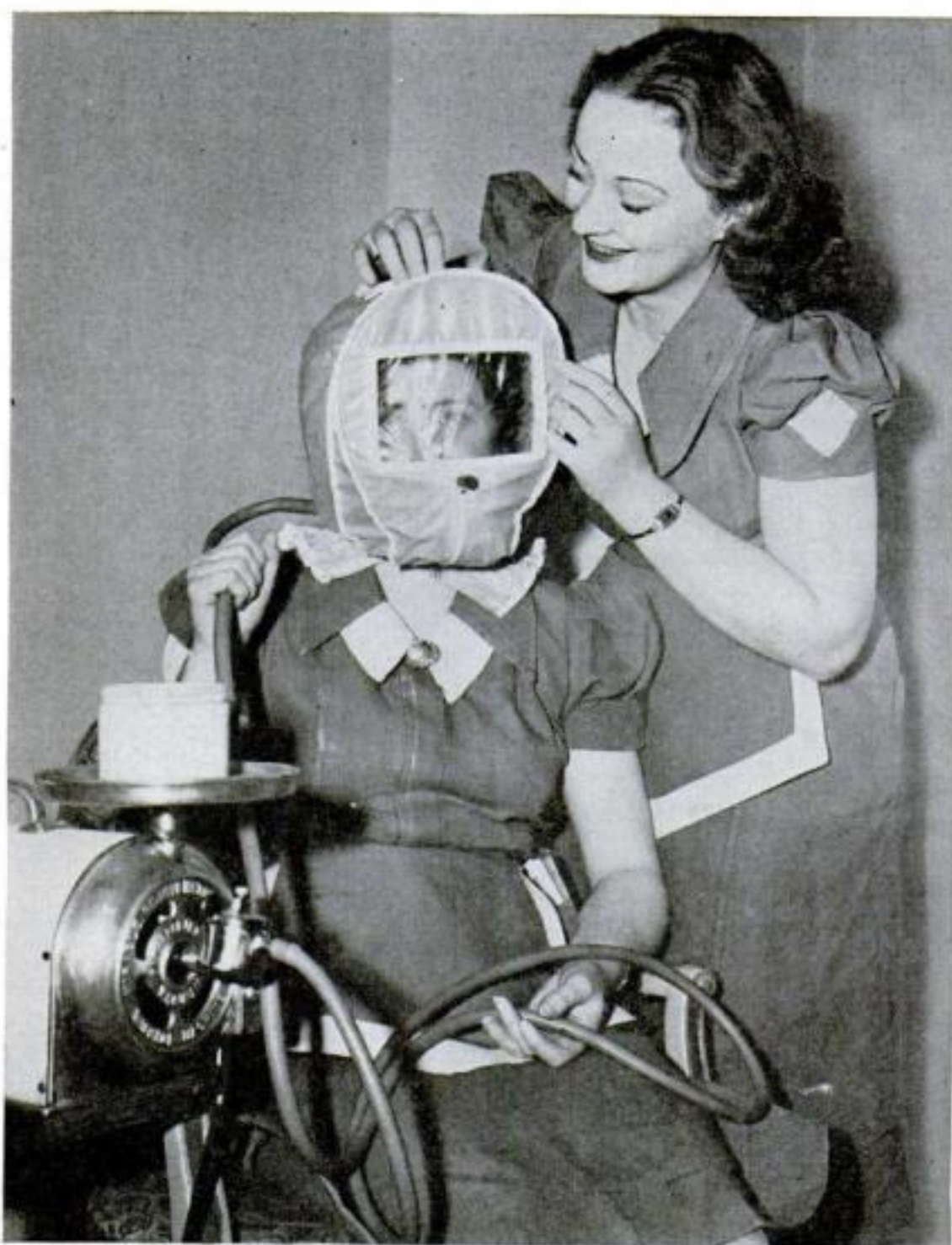


Wire-Haired Brush Mitt Keeps Dog's Coat Neat

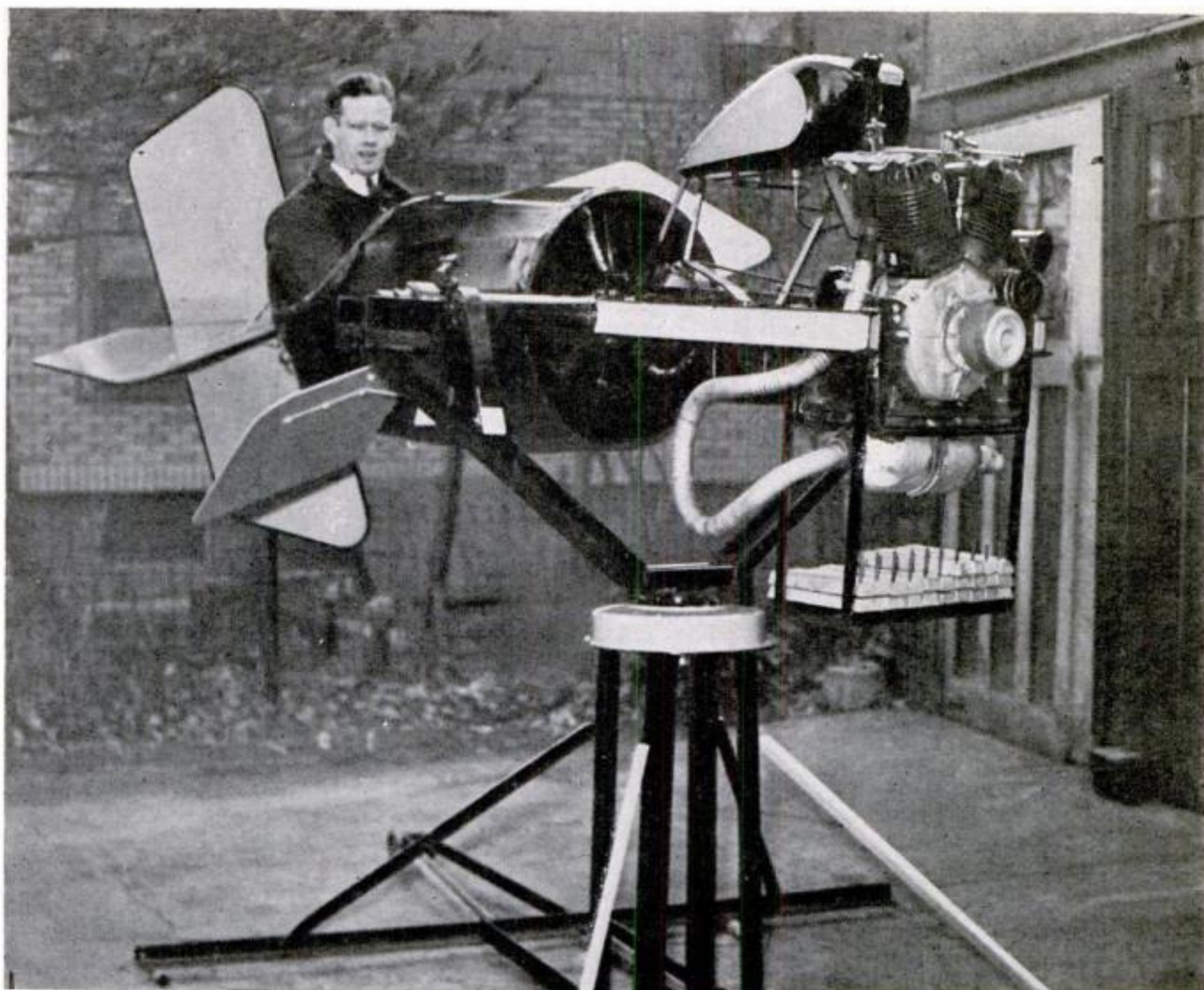
A DOG'S LIFE will be made happier by rub-downs with this canine currycomb, which is a mitt with short wire bristles set in one side. Designed to fit only over the fingers, the mitt has a hole for the thumb and a leather strap and buckle which can be used to tighten it around the wrist and keep it in a comfortable position when in use. The back of the mitt is covered with corduroy to give the dog's coat a final shine. The brush is specially useful for packing the hair of a wire-haired terrier and removing dead hair from long-haired dogs.

"Glamour Bonnet" Provides Vacuum To Aid Complexion

SOME persons believe a mud pack is the answer to the search for a beautiful complexion, others think massage will do the trick, but Mrs. D. M. Ackerman, of Hollywood, Calif., has decided that reduced air pressure is a good treatment. So she has devised a "glamour bonnet" like a diver's helmet with which the atmospheric pressure around the beauty seeker's head can be lowered. The effect is similar to what a person feels who climbs a high mountain or flies high in a plane, and Mrs. Ackerman claims that the reduced pressure stimulates blood circulation and thus aids the complexion to attain its natural beauty. A window has been installed so the customers can read during treatments.



Not a deep-sea diver, but a beauty-parlor patron in the vacuum helmet



Back-yard Aviator Flies Homemade "Gigiscope"

JUST for his own amusement, William R. Gihon, of Springfield, Mass., took some old automobile parts, a motor-cycle engine, and a small propeller and built a "fixed airplane," which his family dubbed a "Gigiscope." It will simulate almost all the motions of a plane in flight.

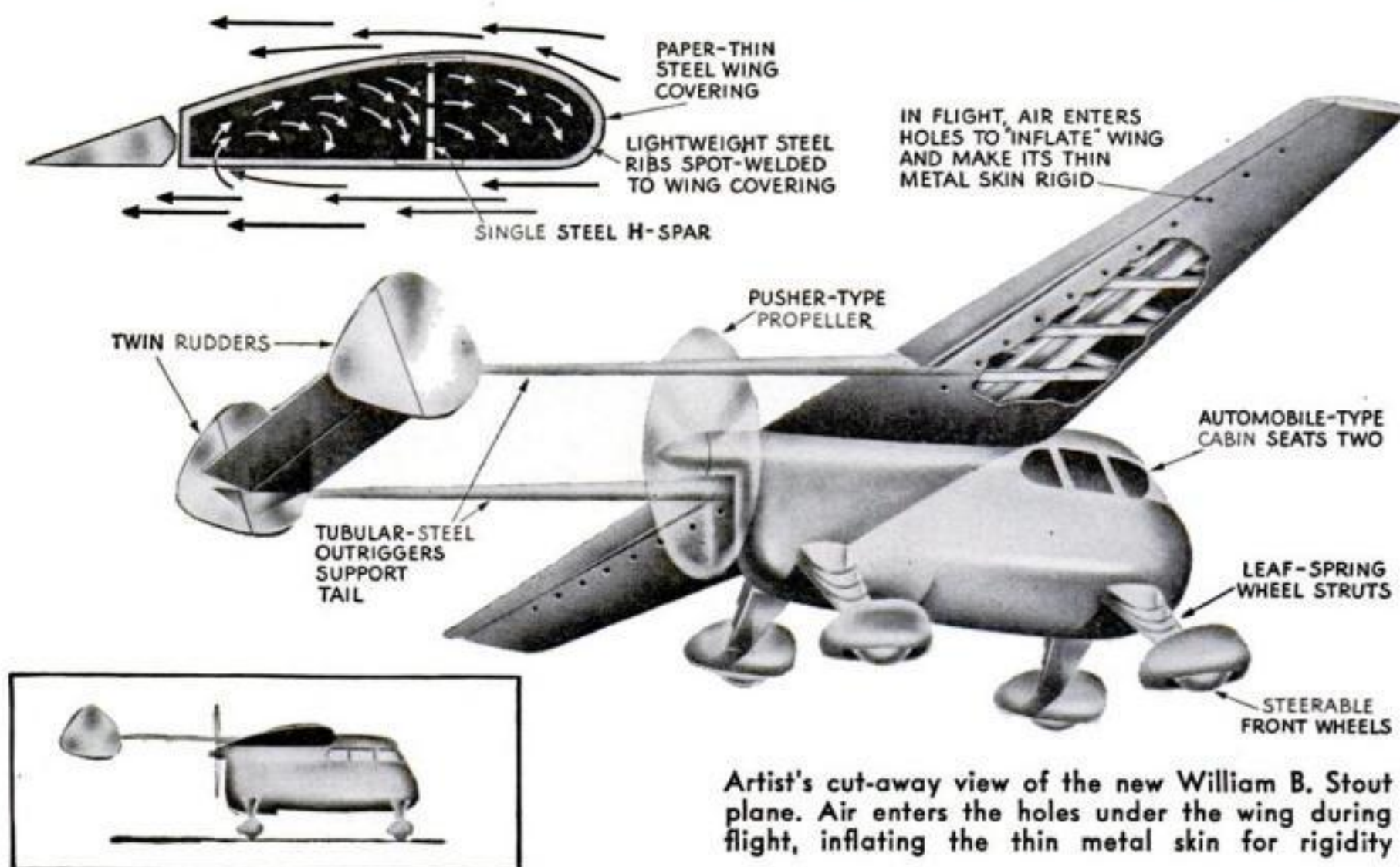
Makes Tiny Racing-Car Models

MAKING model automobiles complete in detail from radiator grilles to tail lights is the hobby of Del Reinhold, of Reading, Pa. Working only with razor blades, sandpaper, tin shears, and a pair of pliers, he has completed twenty midget-racer outfits, with tow cars, trailers, and the racers themselves accurately built to a scale of $\frac{1}{4}$ inch to the foot. The bodies of the cars he shaped from blocks of balsa. The only items purchased were the wheels. Tow cars have finished interiors with seats and all controls.



Model racers, with tow cars and trailers. Note comparison with matches

Air-Inflated Metal Wing Supports Four-Wheel Flivver Plane



Artist's cut-away view of the new William B. Stout plane. Air enters the holes under the wing during flight, inflating the thin metal skin for rigidity

SCHEDULED for appearance this month, a new lightweight stainless-steel plane designed by William B. Stout is of unusual design. Air entering holes under the wing inflates the air-tight, paper-thin steel cover-

ing, keeping it rigid in flight. Its world-famous designer claims that the four-wheel landing gear permits the plane to land safely with the throttle open. It is driven and steered on the ground like a car.

Living Shadow Dances on Giant Electric Sign

PIROUETTING in front of a bank of photo-electric cells, Dixie Dunbar, New York dancer, recently cast a living silhouette on the world's largest animated electric sign above the Great White Way. Her shadow, thrown on the electric eyes, blacked out lights in corresponding areas of the sign. In regular operation, animated-cartoon silhouettes are projected on the cells from a movie film.



As dancer Dixie Dunbar performs in front of a bank of electric eyes, her "shadow" prances across the mammoth sign at left



America Rebuilds Her Merchant Marine



S. S. America, pride of the new U. S. merchant marine, entering New York Harbor on her maiden voyage

By **ROBERT E MARTIN**

Ten Years of Ship Building Are Planned to Add 500 Ships to the U. S. Merchant Fleet

NEW PRIDE is evident today in the bearing of the officers and men of America's merchant marine. New respect is manifested for this nation's sea-going commerce carriers by the personnel of foreign vessels. There's a reason. There are, to be exact, 500 reasons—each one a trader that will fly the American flag in the seven seas. For the merchant marine of the United States, classed by all naval men as an important element of sea power, is well on its way to a revival unprecedented since the World War.

The splashes of many launchings at seventeen shipyards on the Atlantic, Pacific, and Gulf coasts tell part of the story of the miracle being worked to bring the cargo

fleet from obsolescence to a modern, speedy, efficient level. It is a \$600,000,000 building program, under a plan authorized by Congress in the Merchant Marine Act of 1936. It began as a ten-year plan calling for the construction of 500 carriers of many types during that period and for the completion of 50 ships each year thereafter. Unlike the five-year plans and the ten-year plans of some other countries, this one is far ahead of schedule.

The United States Maritime Commission has fathered the launching of almost 100 merchant ships since April 1939, when the first slid down the ways under its auspices. Nearly 100 more are under construction. (New keels are being laid so rapidly that it is difficult at any time to get an exact count. In a single fortnight, eight ships were launched.)

The major accomplishment so far in point of size is the 723-foot passenger liner *America*, largest ever built in this country but soon to be outranked by two 759-foot luxury cruise ships for the Pacific trade.

But the backbone of the program is the mass-production ship. To get the speed in output required by the plan, the Com-



UNITED STATES



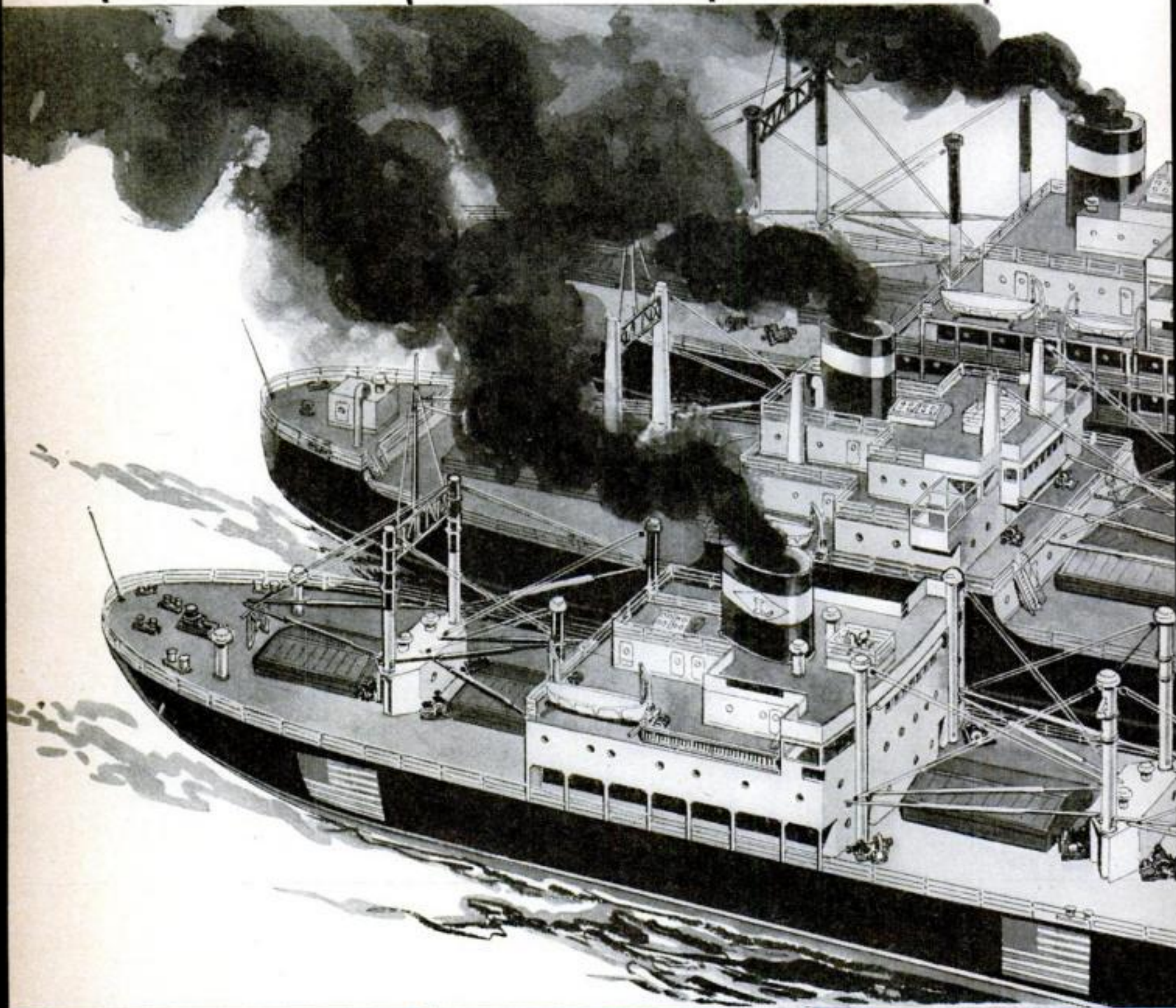
MUNSON



LYKES



CUBA MAIL



C-1 CARGO
12,875 TONS DISPLACEMENT



C-2 CARGO
13,900 TONS DISPLACEMENT



C-3 CARGO
17,600 TONS DISPLACEMENT



C-3 CARGO-PASSENGER
17,600 TONS DISPLACEMENT



CARGO-PASSENGER
14,210 TONS DISPLACEMENT



S. S. AMERICA
35,400 TONS DISPLACEMENT



CARGO
14,450 TONS DISPLACEMENT



TANKER
23,320 TONS DISPLACEMENT



CARGO
15,200 TONS DISPLACEMENT

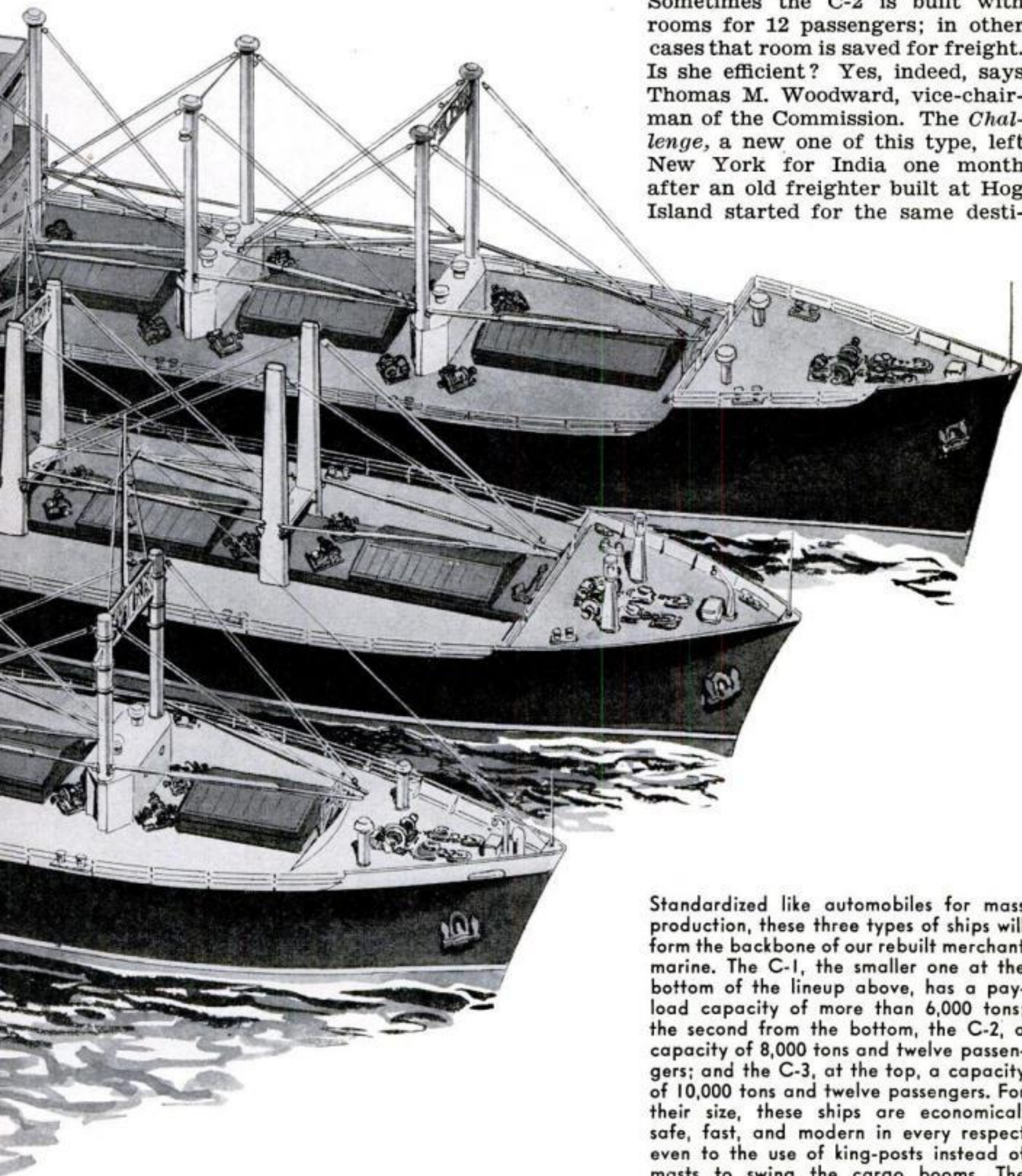
mission decided to concentrate upon a few standard designs, in which ships of certain types would be as alike as Fords or Buicks or Cadillacs.

The Ford of the lot is the trim little cargo ship C-1. (The C stands for cargo.) She turns up 14 knots under average conditions. She is especially designed for economy and

efficiency on runs where high speed is not essential and where large cargoes will not always be available. At that, she'll transport a pay load of more than 6,000 tons, and she can be designed to carry eight passengers.

A bigger sister is the C-2. She'll carry 8,000 tons of cargo at a 15½-knot speed.

Sometimes the C-2 is built with rooms for 12 passengers; in other cases that room is saved for freight. Is she efficient? Yes, indeed, says Thomas M. Woodward, vice-chairman of the Commission. The *Challenge*, a new one of this type, left New York for India one month after an old freighter built at Hog Island started for the same desti-



Standardized like automobiles for mass production, these three types of ships will form the backbone of our rebuilt merchant marine. The C-1, the smaller one at the bottom of the lineup above, has a payload capacity of more than 6,000 tons; the second from the bottom, the C-2, a capacity of 8,000 tons and twelve passengers; and the C-3, at the top, a capacity of 10,000 tons and twelve passengers. For their size, these ships are economical, safe, fast, and modern in every respect even to the use of king-posts instead of masts to swing the cargo booms. The panel shows silhouettes of standard ships



WEST COAST



LUCKENBACH



GULF



AMERICAN EXPORT

nation. They made the same ports. And they got back to New York on the same day, within 15 minutes. The *Donald McKay*, another C-2, set a record for cargo ships from Buenos Aires to New York.

The de luxe model of this series is the C-3, which churns along at 16½ knots, carries 10,000 tons of goods and twelve passengers, and can be built on optional designs that reduce cargo space and give staterooms for 67, 96 or 196 passengers.

The last of the four "quantity-production" types sponsored by the Commission is an oil tanker suitable either for straight commerce or for accompanying and fueling navy ships. Ordinary tankers average about 12 knots. These new twin-screw vessels are designed for 16½ knots and have bettered 18.

The thoroughness of the standardization is demonstrated by the plight of James Gould, who sits with a spyglass in a Western Union lookout tower at the tip of Sandy Hook, N. J., to spot and identify vessels entering New York Harbor.

His job is to telegraph advance news for the benefit of customs and shipping men. For long he has prided himself on knowing by sight most of the ships that entered the country's busiest port. He and his fellow observers kept a card index, the cards bear-



ing neat little sketches of the profiles of ships as seen by day and the arrangement of their lights by night.

But now the Maritime Commission's boats-of-a-type are so alike that at a distance, in daylight, he can tell them apart only by such details as which side of the smokestack the whistle is on! After dark, the observers must ignominiously flash out

on the tower's blinker lights the question, "Who are you?"

Gould doesn't have that trouble with the liner *America*, of course, for she is in a class by herself. Built for the United States Lines and equipped for 2,200 passengers, this ship will be transferred at the end of the war from West Indies cruises to the transatlantic service.

More remarkable than the *America* will be the two transpacific liners on which the Seattle-Tacoma Shipbuilding Corporation of Seattle was the only bidder.

They will be the largest ships ever built in American yards. Specifications call for a displacement of 35,500 tons and a sustained sea speed of 24 knots, although it is expected they will be capable of 30 knots. They will be 759 feet long over all, with a beam of 98.2 feet on the waterline.

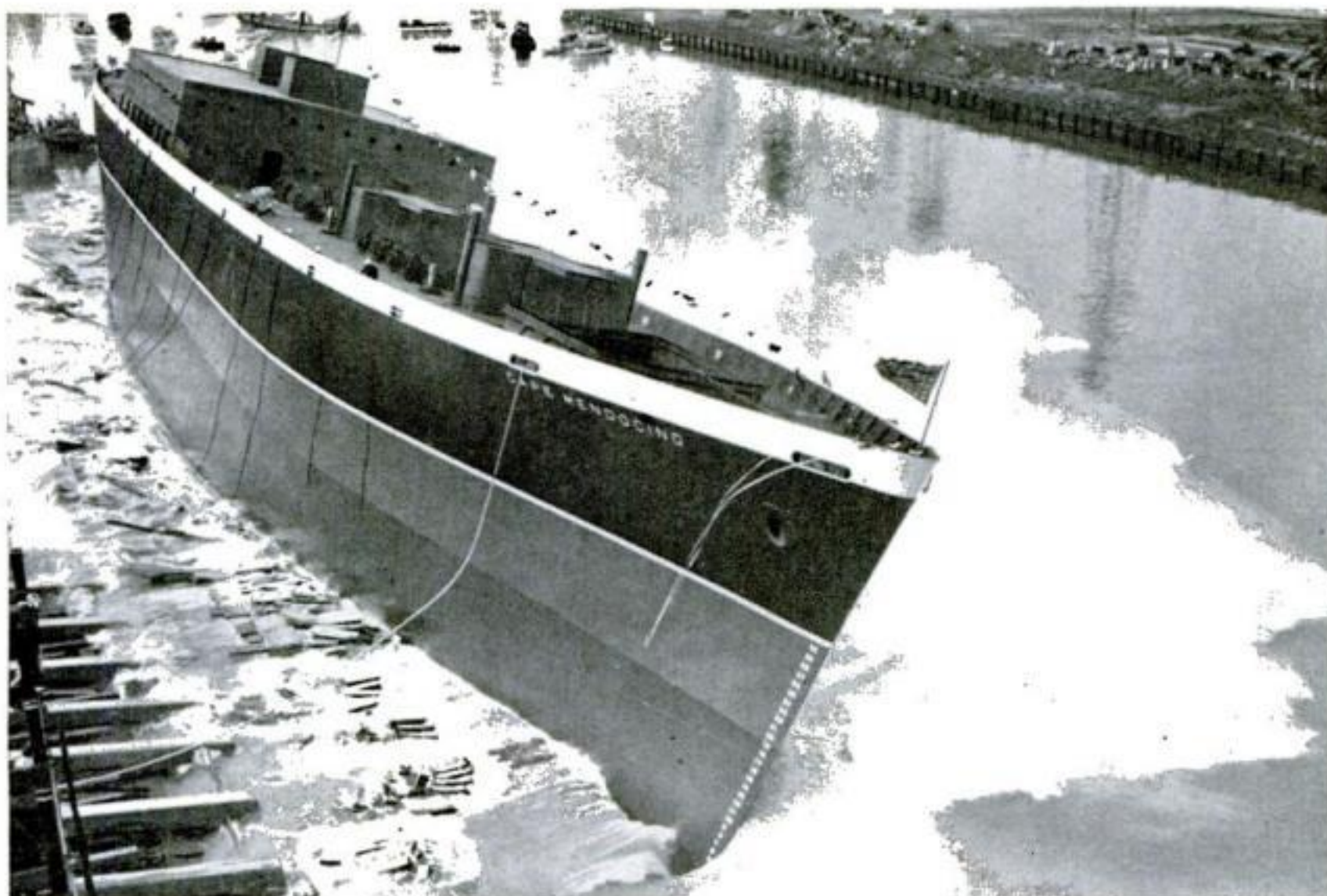
Luxurious accommodations will be provided for a total of 1,000 passengers, and the crew and officers on each liner will be about 500. Cargo space will be provided for approximately 535,000 bale cubic feet.

But the defense angle has not been forgotten. The ships are specially designed, with two funnels located on the side, so that they can be quickly converted into aircraft carriers. And any man in the Navy will tell you that 30-knot aircraft carriers are mighty handy.

From a technical standpoint, *America's* new merchant ships sur-



Admiral Emory S. Land, Chairman of the Maritime Commission, looks over a model for two new ships. The stacks are placed on one side so the vessels can be used as aircraft carriers



Ships are being built in standard models, like cars. The Ford of the program is the C-1 freighter. Here is one of them, the *Cape Mendocino*, sliding down the ways in a shipyard at Long Beach, Calif.

An earlier stage in the construction of the same ship. The C-1 vessels make 14 knots under average conditions, and transport a pay load of more than 6,000 tons. They can be designed to carry eight passengers



pass anything of the type afloat, as witness these comments from the experts who designed them:

1. Standards of safety from fire and foundering greatly exceed those attempted by other countries.

2. The use of steel hatch covers on the uppermost decks, in lieu of wooden hatch covers topped by canvas, brings greatly increased safety from the impact of seas.

3. To prevent loss of control in heavy weather and in other times of emergency, the ships are built with propulsion equipment of inherent ruggedness.

4. Main generators, boilers, auxiliary machinery, and other important units are in duplicate. On Diesel-driven ships of the single-screw type, two engines are generally employed, rather than one per main shaft. Barring damage of reduction gears, the safety of the ship is virtually doubled, since it is hardly to be expected that both engines will fail simultaneously.

5. Safety is further enhanced by the location and grouping of machinery controls, alarms, and warning signals so that control is in the hands of experienced operators, who are on the alert and ready instantly to obey the instructions of those in command.

6. On a cargo vessel, where a 24-hour watch in the radio room is not maintained, an auto-alarm permits 24-hour reception of distress signals.

7. The ships are divided, by vertical fire-resisting bulkheads, into main zones not more than 131 feet long, beyond which a fire in any cargo hold, living or working space cannot spread. Thus there is not a *Morro Castle* among them.

8. Stairways for escape from each main zone are of steel, inclosed with fire-resisting material of the same construction as the main fire bulkheads.

9. Fire detection is both automatic and by systematic patrol including permanent watchmen's records. By an automatic

smoke-detector system, smoke can be seen in the fire detector cabinet, issuing from a numbered orifice, indicating the space where smoke is present.

10. Metal lifeboats and motor lifeboats, meeting the high standards of the Bureau of Marine Inspection and Navigation in number and construction, are provided.

The Commission also has established a far-reaching plan to provide officers for the expanding merchant fleet. This cadet-training program is administered by its Division of Training. At the training station at Hoffman Island, New York City, which is the largest, the trainees go in with the knowledge that those who pass the examinations will have jobs with a future.

They learn the duties of the engine and deck department. They are also required to complete study courses while on the vessels, such as engineering, navigation, physics, communications, mathematics, first aid, and ship hygiene. Minimum pay for cadets is \$50 a month, plus food and quarters.

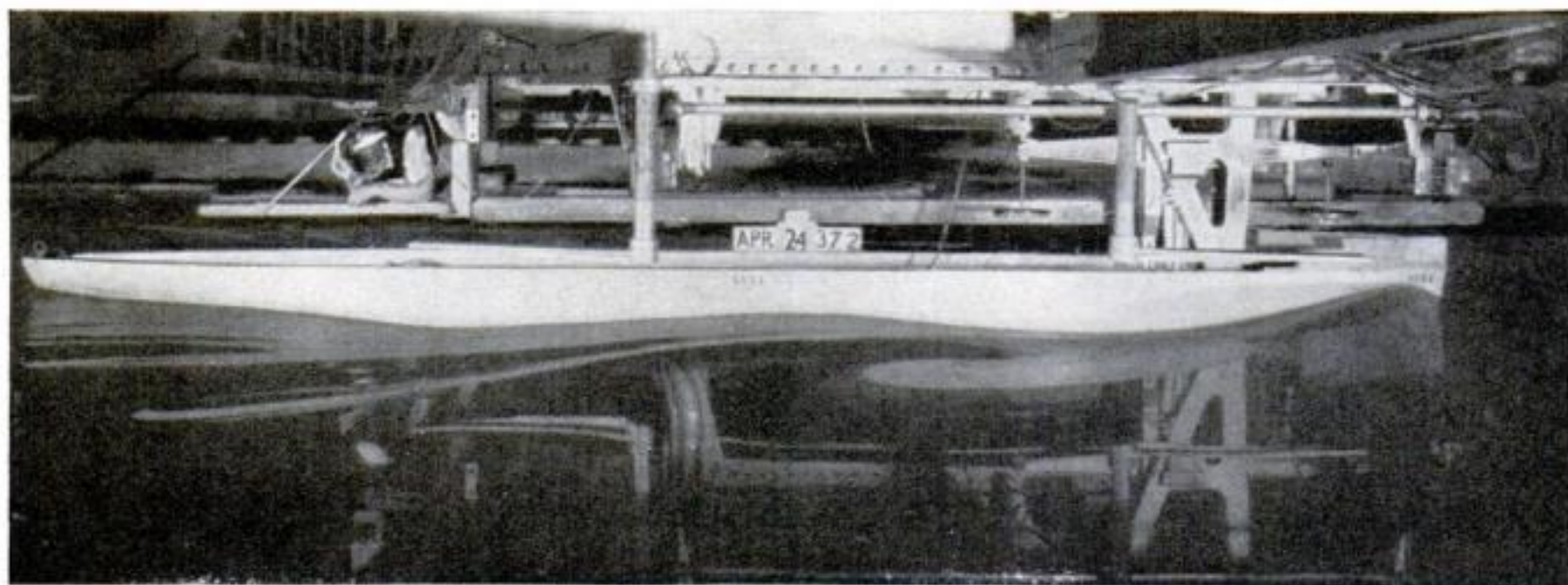
After completing three to four years of service as cadets, the men may take examinations of the United States Bureau of Marine Inspection and Navigation to obtain a Third Mate's or Third Assistant Engineer's license.

Cadets and cadet officers are not used to displace required members of the crew. They are quartered with the licensed officers and mess with junior licensed officers.

In 1939, vessels of United States registry had passenger revenue in the overseas traffic of \$42,000,000, as compared with \$37,000,000 in 1938. Part of that was due to the war, of course, but a greater part was due to the new efficiency of the American ships. And the increase continued in 1940.

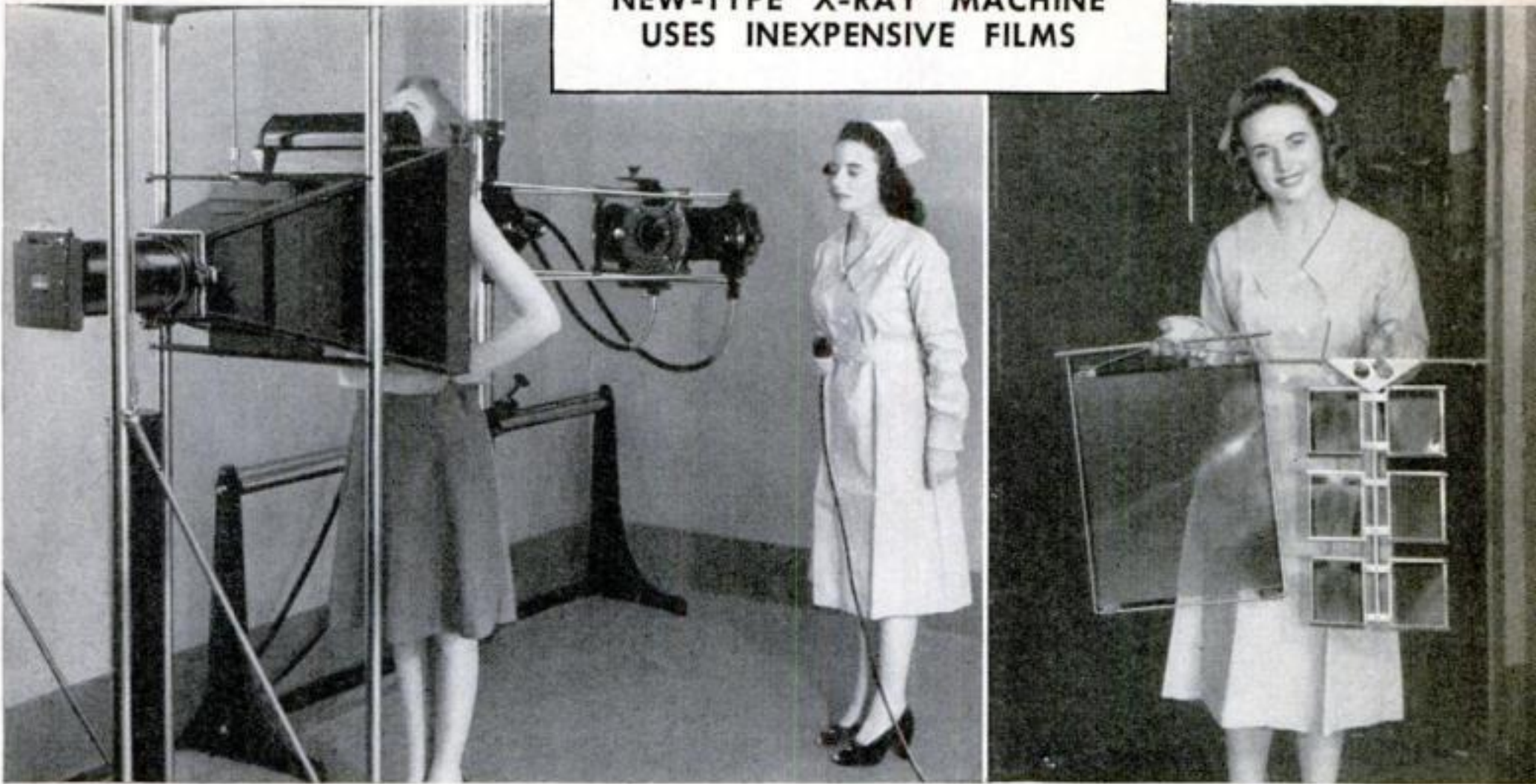
So it is that Rear Admiral Emory S. Land, U. S. N. retired, as chairman of the Maritime Commission, was able to say:

"I think we are going somewhere, given peace, with our new ships."



Model of a C-3 cargo ship being tested in the Washington Model Basin for a speed of 18 knots

NEW-TYPE X-RAY MACHINE USES INEXPENSIVE FILMS

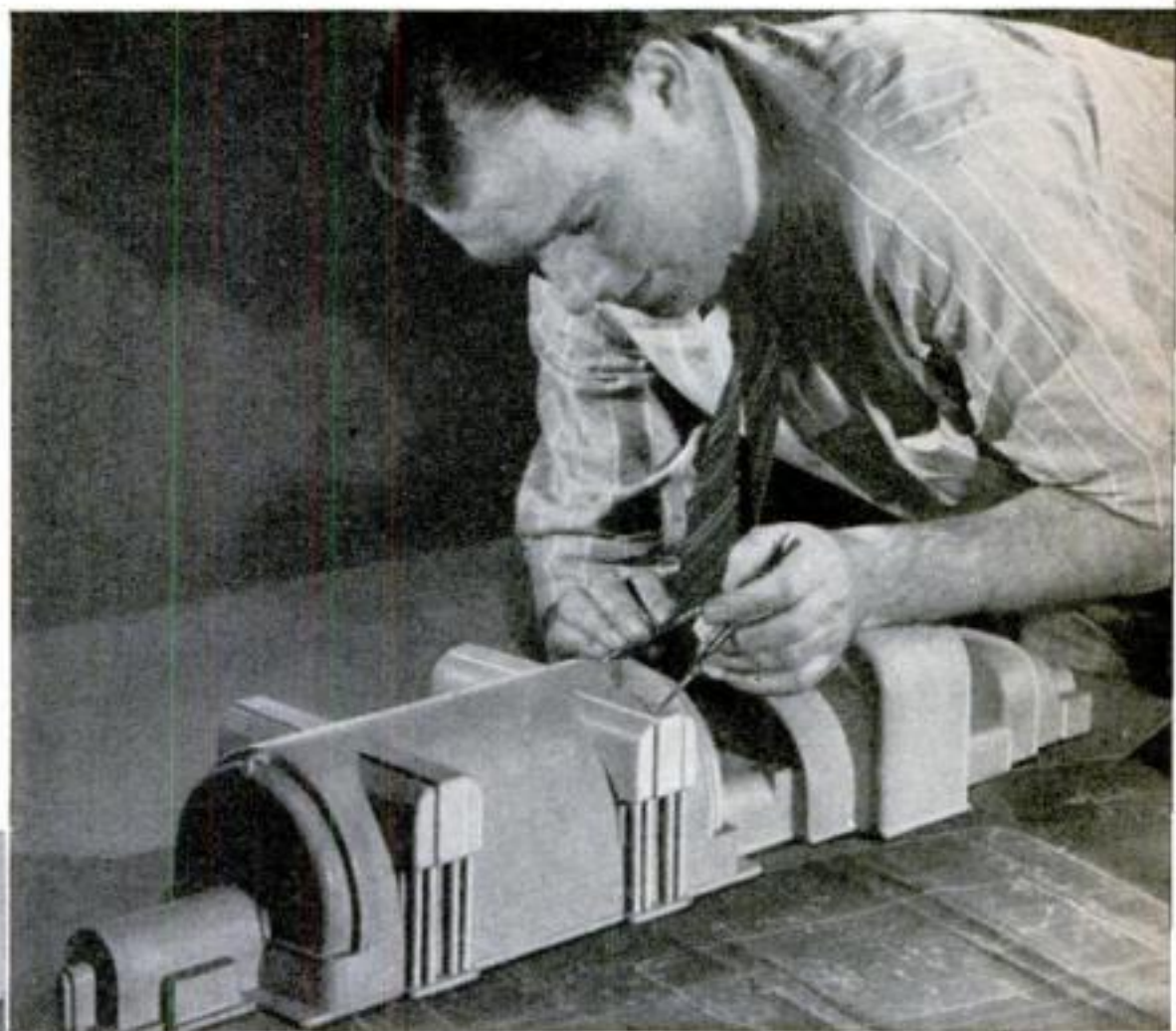
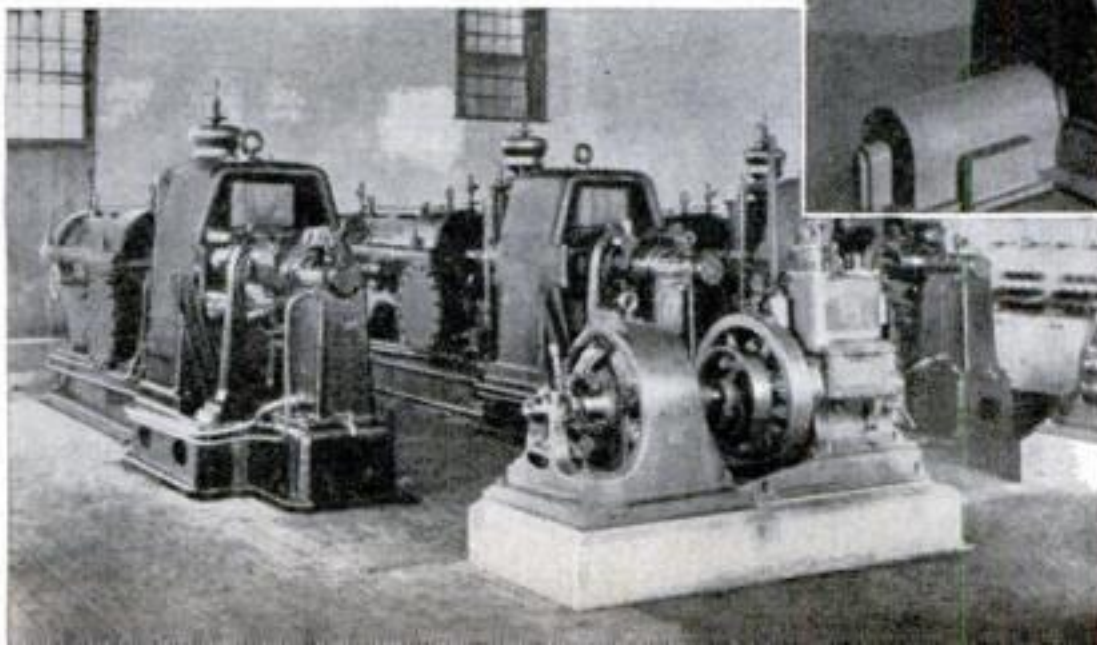


X-raying a patient's chest with the new camera. At the right, a technician compares six of its low-cost 4 by 5-inch pictures with one 14 by 17-inch photograph made with a standard machine

X-RAY PHOTOGRAPHS of the chest and other parts of the body can be made on a four by five-inch negative instead of the customary 14 by 17-inch film, with a camera developed by the General Electric X-Ray Corporation. Pictures are produced quickly and at reduced cost.

CHANGING STYLES IN POWER PLANTS ARE ILLUSTRATED

in these pictures of the old and the new. At the left is the first steam turbine built by George Westinghouse in 1896. It produced a mere 120 kilowatts. At the right is a model, scaled $\frac{1}{2}$ inch to the foot, of a 65,000 - kilowatt turbine - generator which is being built at the South Philadelphia and East Pittsburgh plants of the Westinghouse Electric and Manufacturing Company. When completed it will be installed at the Waterside Station of the Consolidated Edison Company of New York.

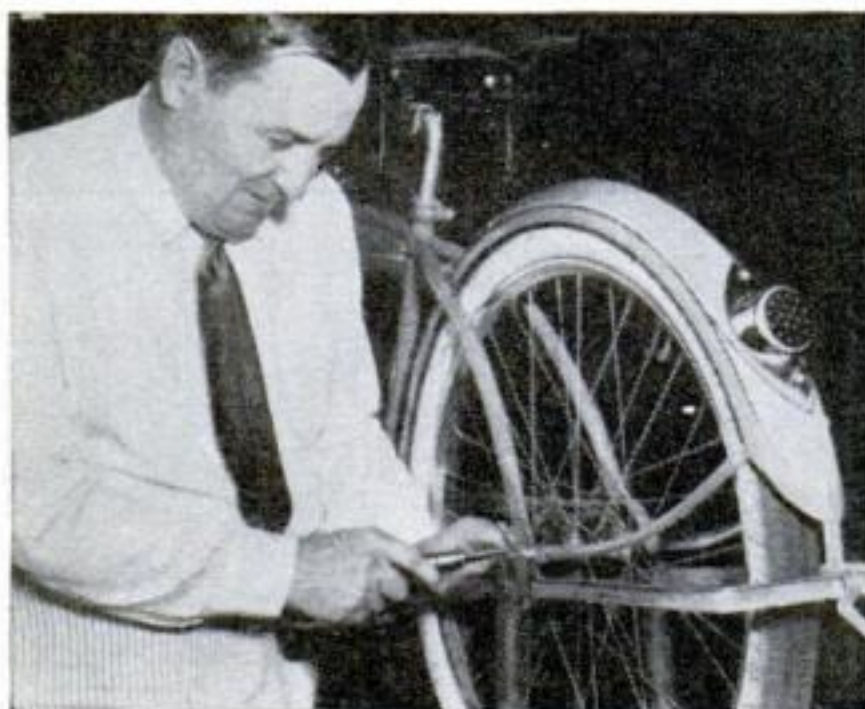


Note how streamlining has changed the appearance of turbine generators since Westinghouse built the one on the left

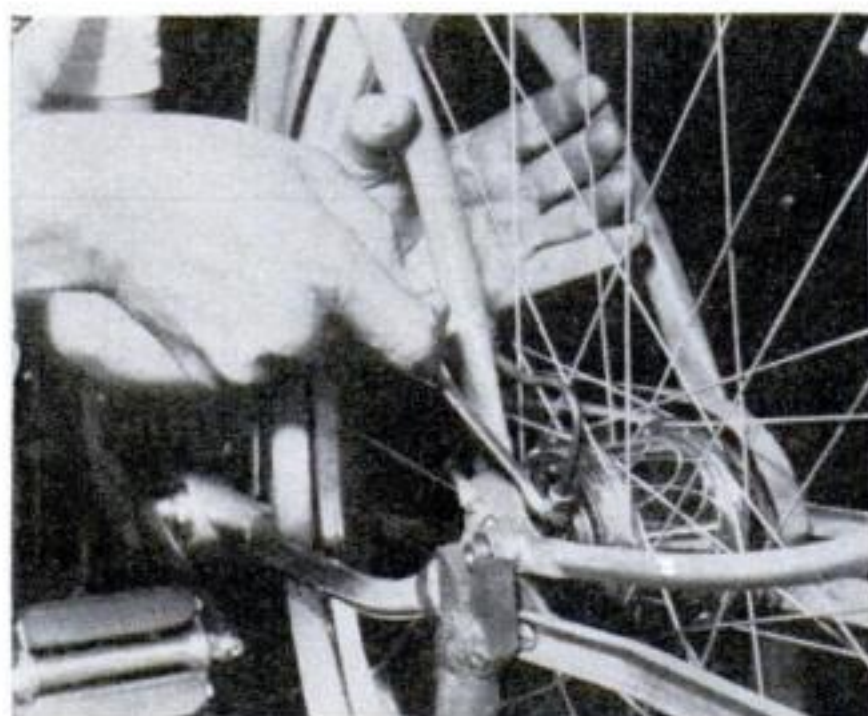


Atoms and Molecules Form Chemical Building Set

CHEMICAL building blocks, detachable from cardboard sheets, solve the mysteries of formulas, valence, and equations for youngsters. To symbolize a molecule of water, for instance, two hydrogen blocks are joined to one oxygen block. Misfits call for rearranging the blocks. Thus the junior chemist above is translating the rather complicated formula for calcium phosphate, $\text{Ca}_3(\text{PO}_4)_2$, into an easily remembered picture. Other symbols enable a whole chemical reaction to be written out pictorially, as illustrated by the examples in the background.



H. L. Mueller adjusts the rear-wheel drum and feed line on a test model of his hydraulic bike brake . . .



. . . which is shown in detail here. The tube carries fluid whose pressure is controlled at the handlebar

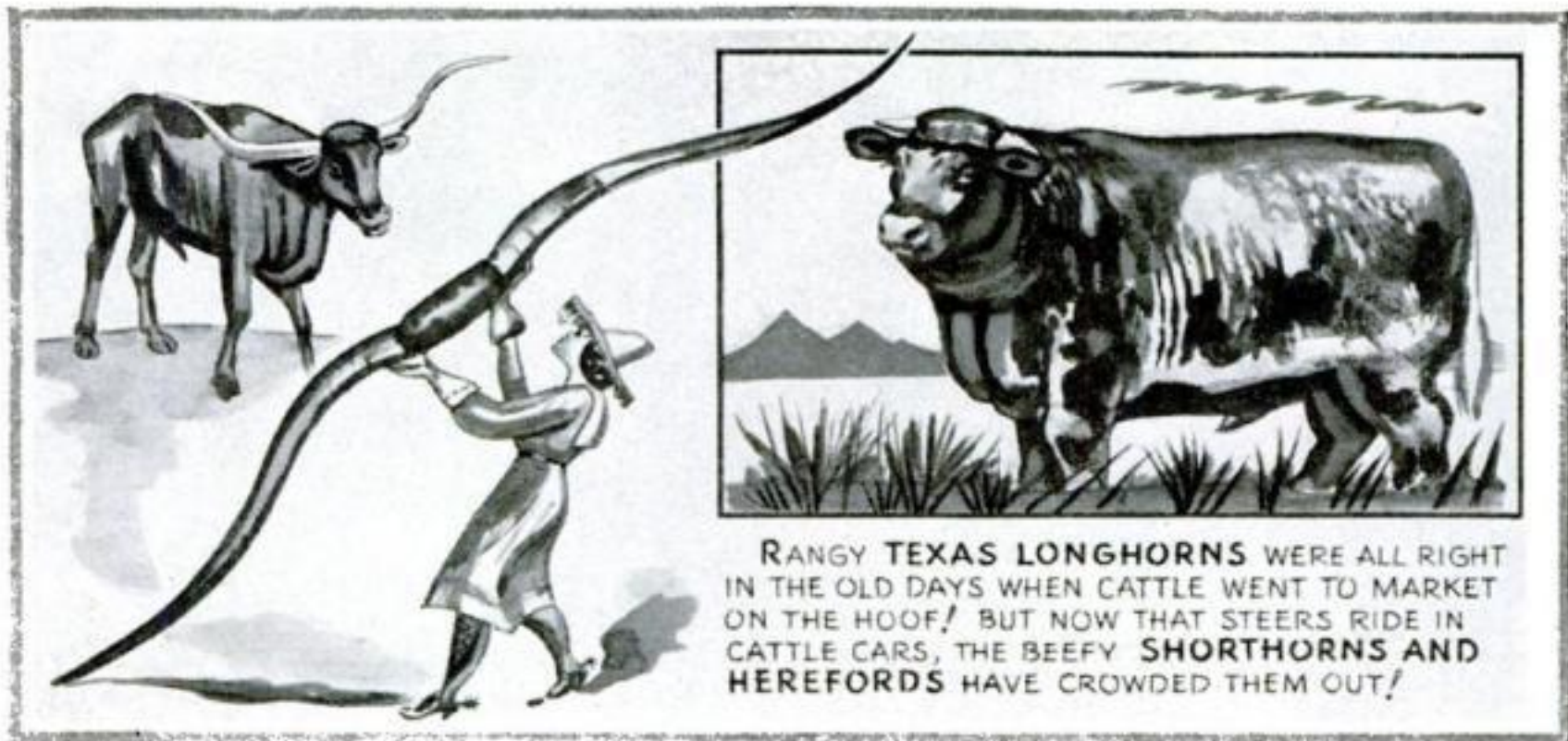
Hydraulic Brake for Bicycle Controlled from Handlebar

OPERATING smoothly but powerfully, a hydraulic brake for bicycles has been designed by H. L. Mueller of Cleveland, Ohio. Instead of back-pedaling, as in using a standard coaster brake, the rider simply

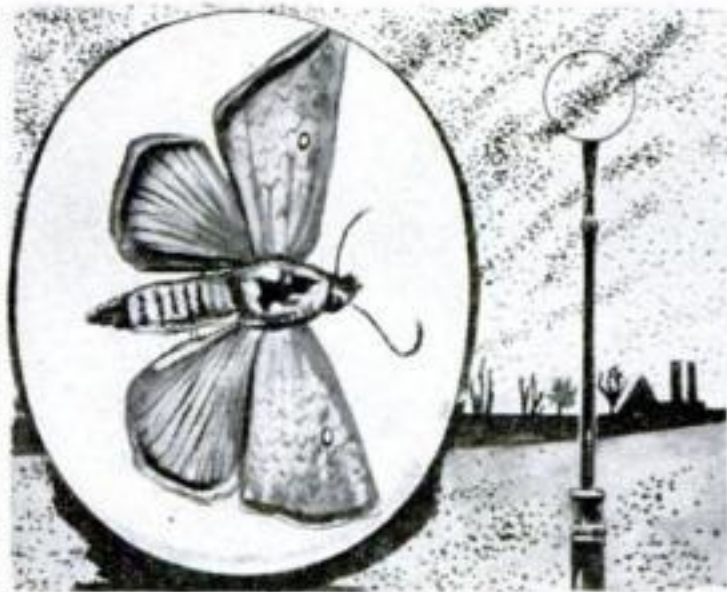
gives the right-hand grip of his handlebars a quarter turn. This forces the hydraulic fluid through a metal tube to the rear hub of the bike, and applies pressure to a brake drum to slow the wheel.

Un-Natural History

BY
Gus Mager



MIGRATING IN THE SPRING FROM THE TROPICS TO OUR COTTON STATES, THE **COTTON-WORM MOTH** DOES NOT RETURN SOUTH IN THE FALL! INSTEAD, HE PUSHES ON NORTH TO SWARM AROUND LAMPS IN NEW ENGLAND AND CANADA!



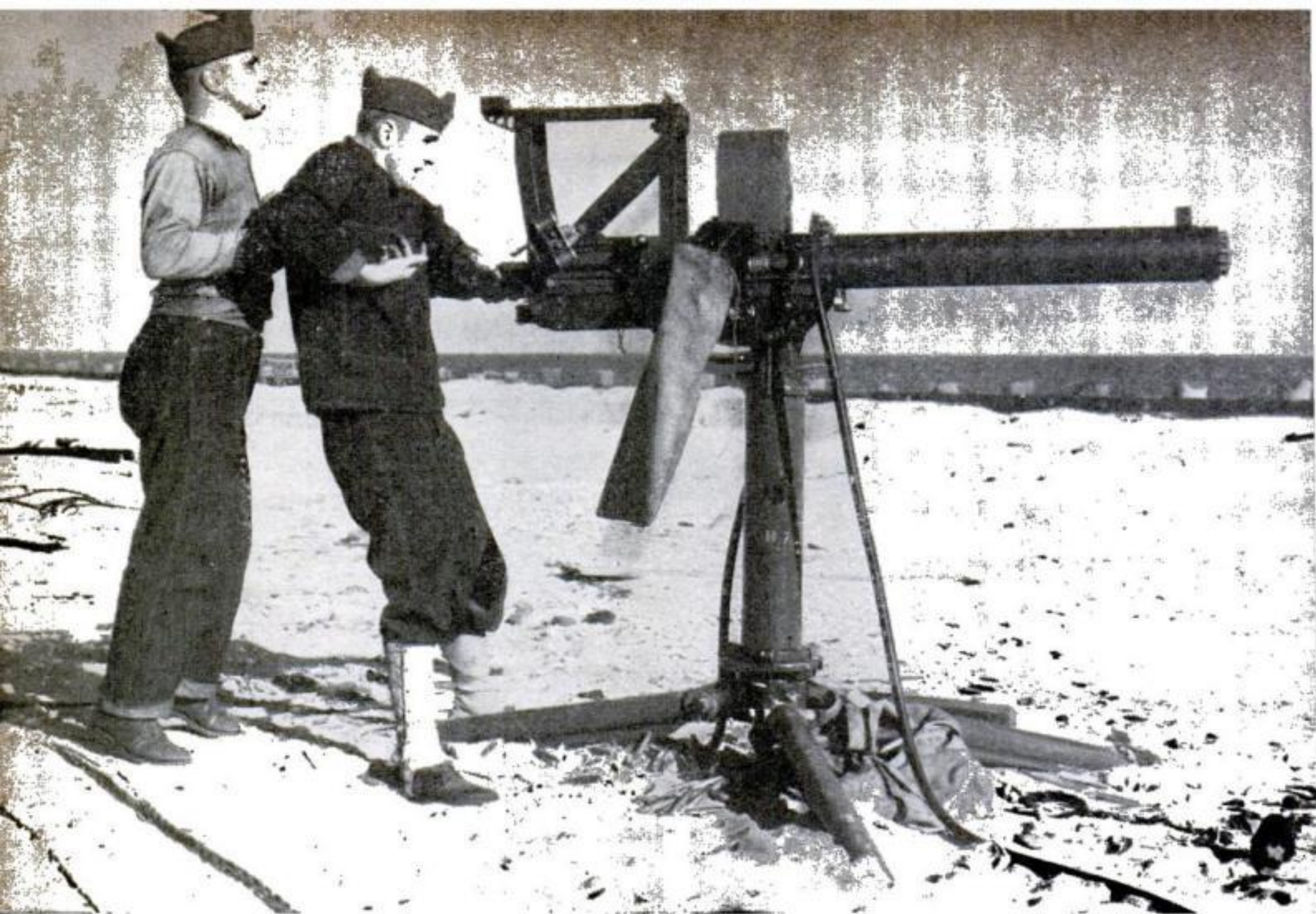
GREYHOUNDS HUNT BY SIGHT ALONE, INSTEAD OF FOLLOWING THEIR NOSES LIKE OTHER HOUNDS! AND THEY RUN IN SILENCE, WHILE THEIR FLOP-EARED COUSINS HOWL, OR BAY, WHILE TRAILING!



THE STRANGE PLANT **EUPHORBIA CANARIENSIS**, OF THE CANARY ISLANDS, THRIVES ONLY WHERE ITS ROOTS CAN TOUCH LAVA ROCKS! IT SECRETES A STINGING JUICE USED BY THE NATIVES TO STUPEFY FISH!

YOU'D THINK THAT ALL **FROGS** WOULD NEED TONGUES TO CATCH THEIR FOOD, BUT IN TROPICAL AFRICA LIVES A CLAWED FREAK THAT IS ABSOLUTELY TONGUELESS!





Like a tenderfoot at a rodeo, a recruit cringes from the kick of a "chatterbox." After training he . . .

STUDENT SOLDIERS LEARN TO RIDE THE BUCKING .50 CALIBERS

EQUALLY effective for offense or defense, these .50 caliber machine guns of the 62nd Coast Artillery (antiaircraft) Battalion at Fort Tilden, New York, are a good example of where a modern army gets its tremendous fire power. In a single minute each gun can spit 600 bullets, with a total weight of 150 pounds, and each bullet can penetrate $\frac{5}{8}$ of an inch of armor plate at a 500-yard range, or six inches of concrete at 100 yards. Firing one of them for the first time is like climbing on the back of a wild horse. These are basically the same weapons that are being installed in modern tanks, planes, and torpedo boats, though in many cases these latter are air-cooled instead of liquid-cooled. Gun crews for these "chatterboxes," consisting of a corporal and five men, require strong arms, healthy nerves, and months of training.



. . . will ride it like this Coast Guard officer



Six .50 caliber machine guns of the 62nd Coast Artillery in action. In real fighting, these guns would be hidden in pits for protection



Five men and a corporal make up a gun crew. Sights are corrected automatically by the "synchronizer" below, to which they are connected by means of cables



In "water practice," below, the target is a raft towed by a boat, simulating a tank (Continued)





Recruits try their hand at loading ammunition belts for the day's practice. Defective cartridges are sometimes included to test gunners. Belts of 100 or 200 rounds . . .

. . . are placed in ammunition boxes like the one seen at the right, which fits on a bracket at the side of the gun. This box, holding 200 rounds, weighs about 80 pounds

To show which guns of the battery make hits on a plane-towed target sock, each crew tips its bullets with paint of a different color, which leaves telltale marks on cloth





One of the guns firing away at a target in the air. The gunner has to aim directly into the sun, because that is the direction from which an enemy dive bomber would attack

Such tremendous heat is generated during firing that the guns must be cooled by water forced through jackets from pump chests like this. In cold weather, antifreeze is used

When the "cease firing" is sounded, the towing plane drops the target sock and the battery commander checks the hits as below. It seems that the boys did a good job (Continued)





An officer keeps in touch with the target-towing boat or plane by walkie-talkie radio . . . and a siren replaces the bugle for giving the command to commence or cease firing



From a sand dune, the safety detail watches to see that nobody gets hurt, though six guns are firing 500 to 600 shots a minute each. The red flag gives a warning that firing is going on

Captain Shive (at right, below) and the safety officer check the course of the plane towing the target sleeve. A 45-degree angle must be formed by plane and sock





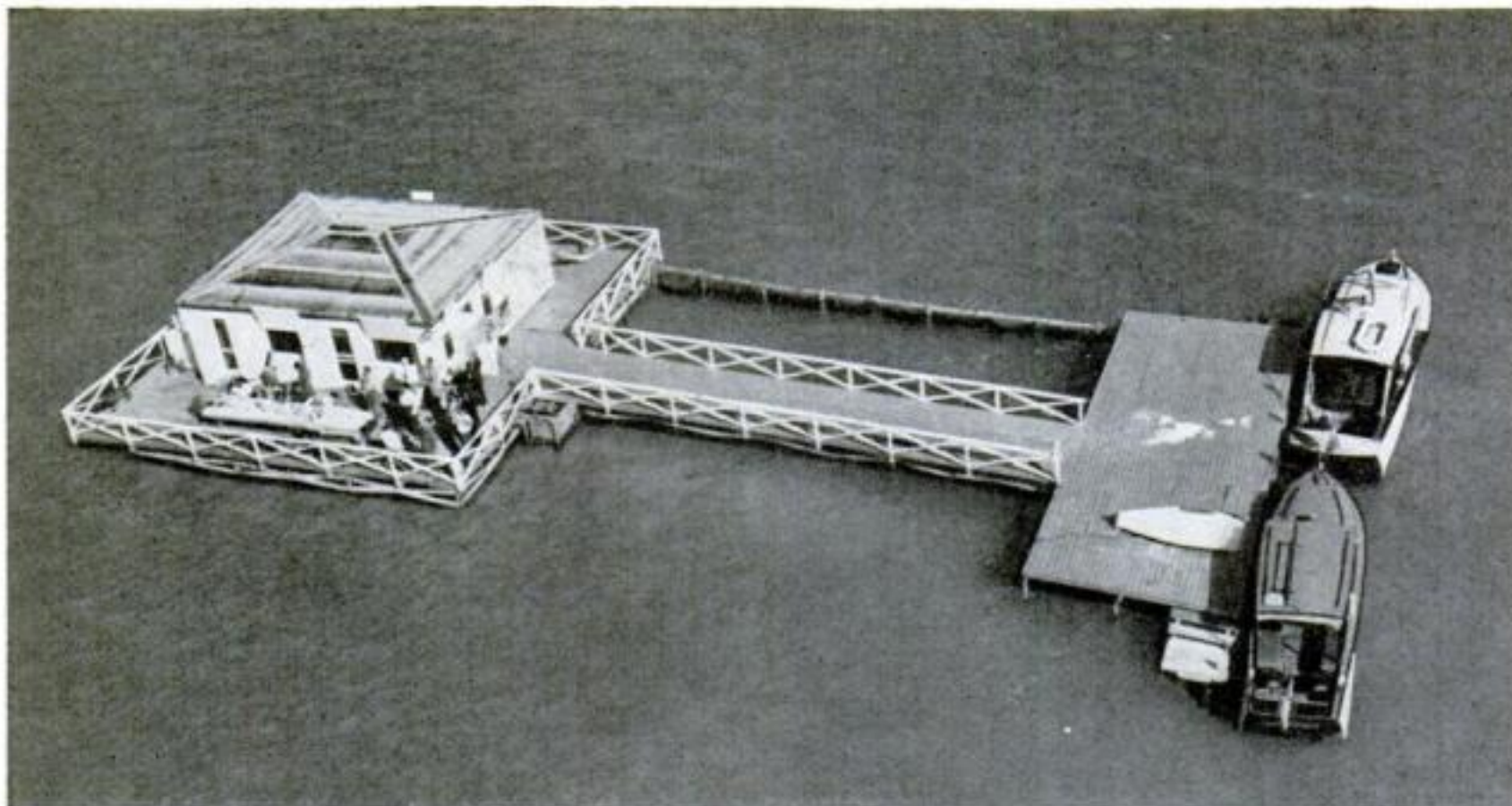
Men working the battery commander's telescope keep constant track of towing plane and target



Telephone lines connecting the various groups through this portable switchboard carry firing data and commands



MARCH, 1941



Visitors to this home on piles drive up in boats instead of cars; the dooryard is a dock

Floating Homes

PROVING that there's more than one way to go to sea, Miami, Fla., residents are building homes 11 miles offshore in Biscayne Bay. They rent land under the water at \$1 an acre, sink some pilings and put the house on top. Some add sharkproof

swimming pools by sinking more pilings and running an underwater fence around them. They can then enjoy all the pleasures of the sea during the boat trip from shore to shack—unless they get seasick, and on Biscayne Bay seasickness isn't likely.



Dinner on deck: A fish fry at a home on Biscayne Bay, after the "piece de resistance" has been caught right out in the back yard

Right: A bedroom in one of the houseboats near Miami's Quarterdeck Club. It has just been redecorated in luxurious style

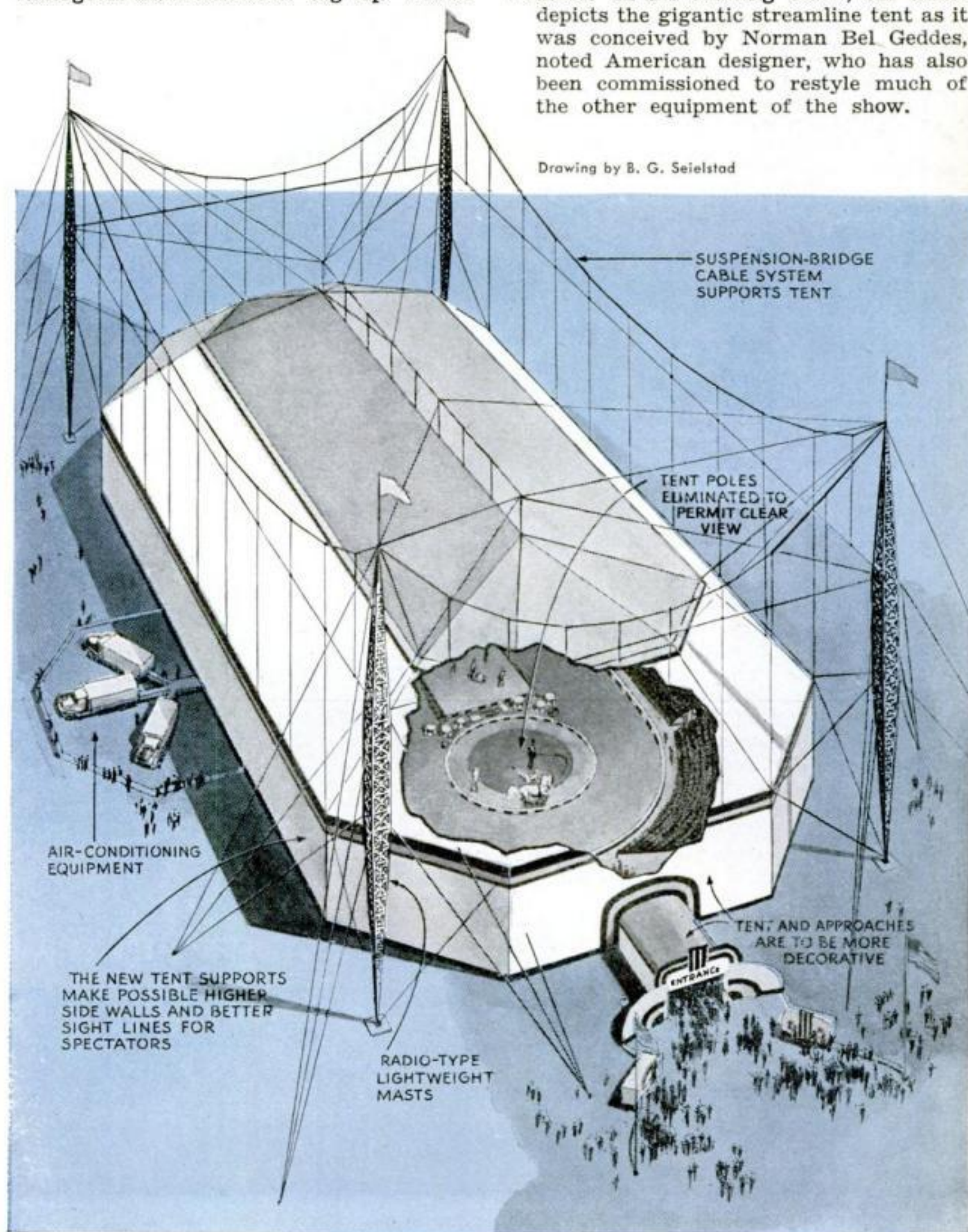


Four Steel Towers Support New Poleless Circus Tent

DISPENSING with inside tent poles, ropes, and braces, a new circus tent being built for Ringling Brothers Barnum and Bailey Circus will be supported entirely from the outside on cables strung between four huge metal masts set on flat bases and steadied by guy wires. The principal advantage of the modernized "big top" will be

the removal of the many inner obstructions that now cut down the spectators' visibility. In addition, the structural innovations will permit the tent to be raised in half the time now required. Air-conditioning units mounted on trucks will force in treated air to add to the spectators' comfort in warm weather. In the drawing below, our artist depicts the gigantic streamline tent as it was conceived by Norman Bel Geddes, noted American designer, who has also been commissioned to restyle much of the other equipment of the show.

Drawing by B. G. Seielstad

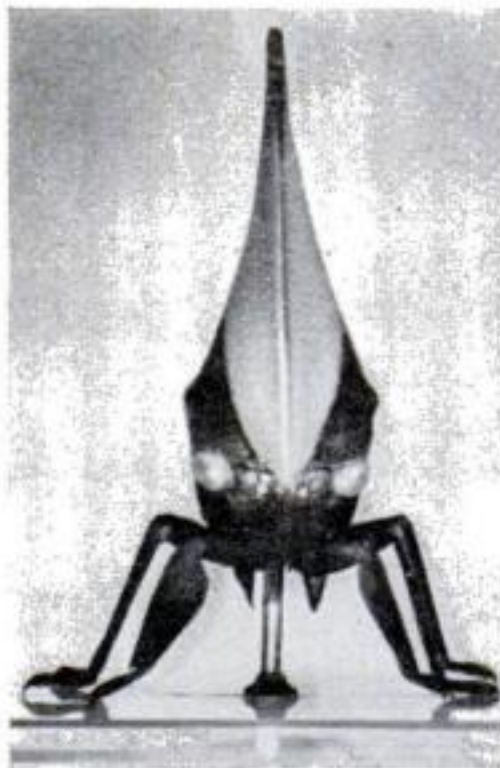


Tree Hopper

FANTASTICALLY shaped tree hoppers, midget insects so grotesque in appearance that they commonly are called "insect brownies," are represented by magnified models of tinted beeswax in a display at the American Museum of Natural History, New York City. By increasing the bulk of these half-inch relatives of the 17-year cicadas as much as 4,000 times, the wax models reveal details of their strange horns and protuberances. The purpose of these bizarre bodily decorations is a mystery. The museum display was created by Ignaz Matauch, an Austrian-born model maker. Beeswax was employed because of its fine texture, the fact that it takes oil colors well, and because it is the most resistant of all waxes to heat. In creating these exact, magnified reproductions of East Indian and North, Central, and South American tree hoppers, Matauch first produced a clay model on a framework of wire, then made plaster casts of the different parts, and into these molds poured the beeswax to harden.



Here is Ignaz Matauch's beeswax model of *Membralis fasciata*, a tree hopper from South America. The actual insect is 13 millimeters long



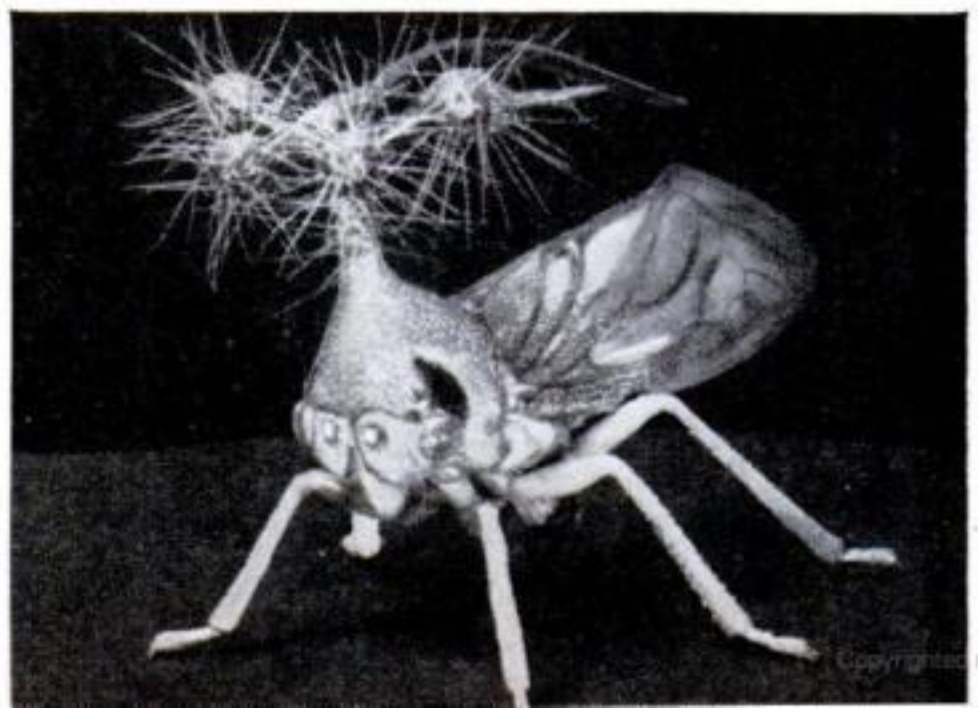
It might be said that *Sphongophorus longifrons* looks about as strange as its name sounds

At left, the same curious creature seen bow-on. The insect is eight millimeters high; the model is 64



Bristles from a shaving brush were used to supplement beeswax in this model of *Bacydium globulare*

Below is *Bacydium* again, with the bristles showing more clearly. The insect is five millimeters high



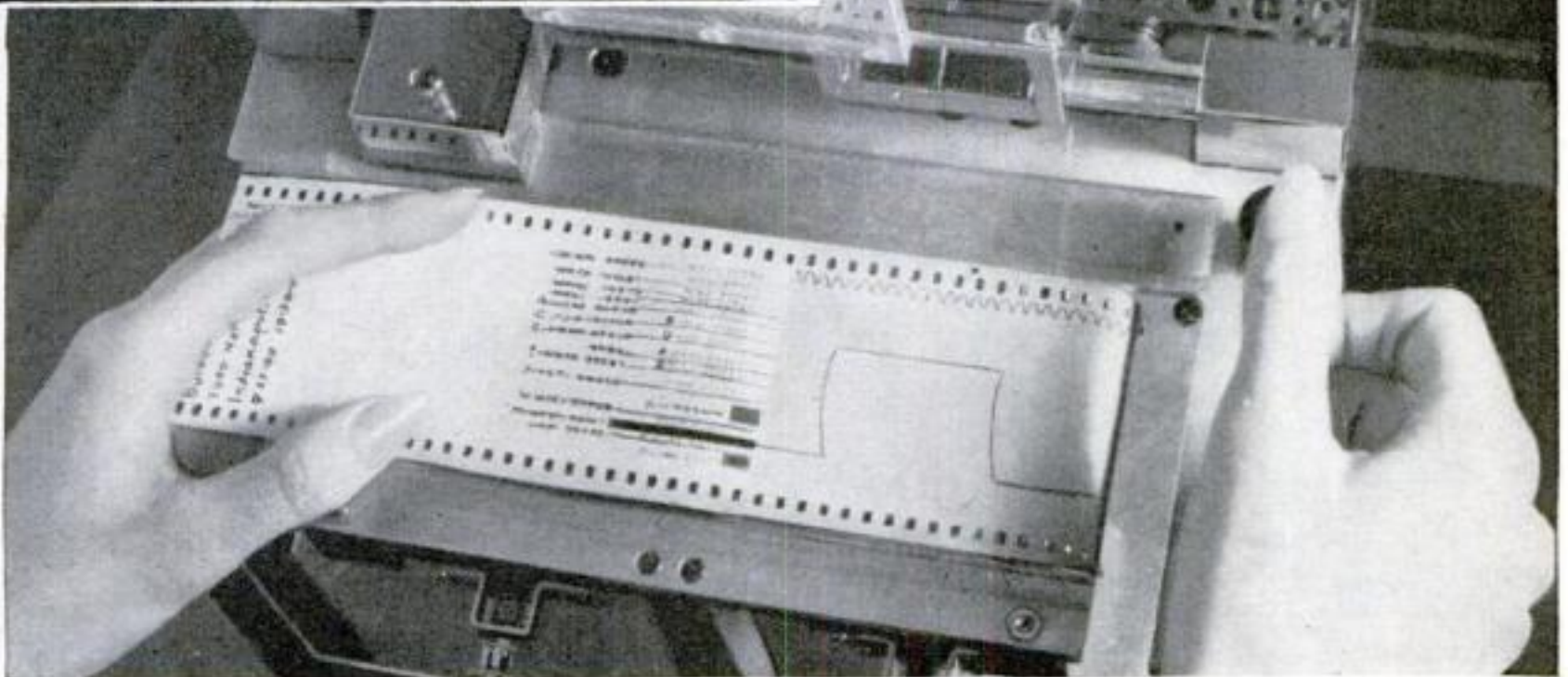
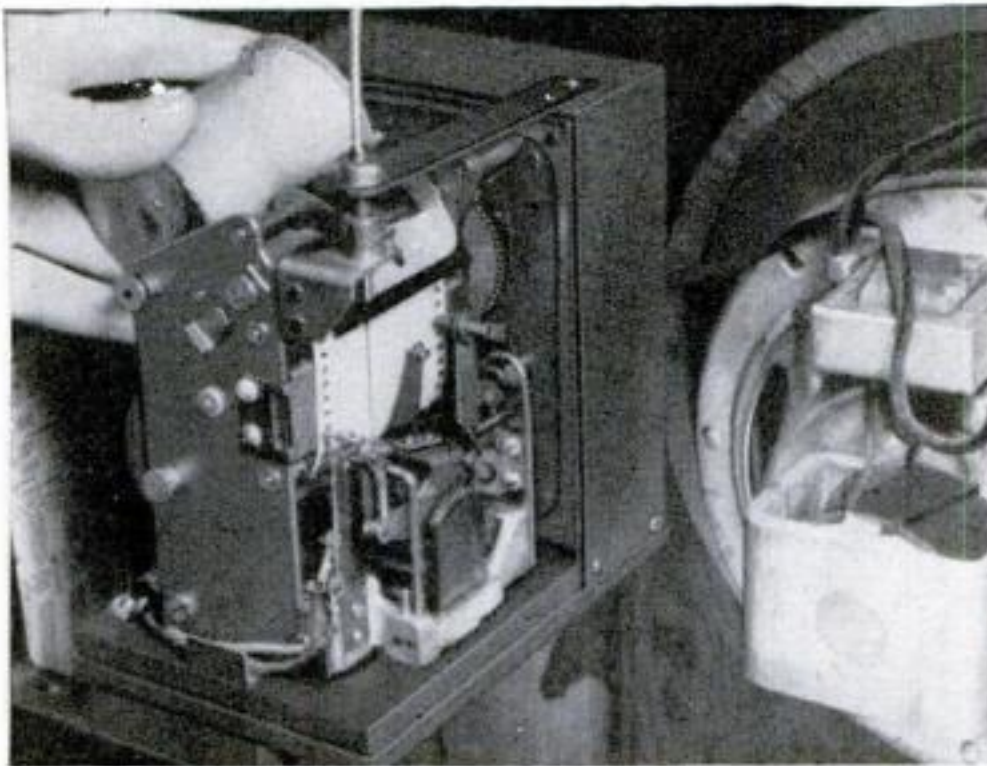
Radio Meter Checks Listening Habits

ACCURATE records of the listening habits of the nation's radio audience now may be compiled with virtually no inconvenience to the listeners involved. It is done with a recording machine operated by a cable attached to the condenser of the radio set. Housed in a small metal box, the recorder can be tucked away in the radio cabinet or, in the case of table models with small cabinets, in a near-by drawer or cupboard. Working through the cable, a stylus in the recorder transcribes on a moving tape a day-by-day, hour-by-hour and minute-by-minute record of when the set was turned on and off, what stations were tuned in, and for how long. Once each month a representative of the company operating the recorder places a new tape in the machine and sees that it is operating properly. The marked tape is removed and sent to a central office, where the information is filed with similar data from sets in other parts of the country. Statistics on what people listen to, by classes of homes, racial groups, geographical locations, etc., are then compiled.

The tape, with a month's recording, is taken from the meter. Note stylus, in the center of the tape (left)



A checking representative removes the cover from a radio meter, installed in the cabinet of a push-button set



Tape is decoded by comparison with a calibration of each station that can be tuned in on that set



Here's My Story

TODAY, MAJOR ALBERT W. STEVENS IS WORLD FAMOUS AS AN AERIAL PHOTOGRAPHER



BORN IN BELFAST, ME., MARCH 13, 1886, HE GRADUATED FROM THE UNIVERSITY OF MAINE IN 1907



WORKING AS AN ENGINEER IN GOLD FIELDS OF ALASKA AND THE PACIFIC COAST, HE PRACTICED PHOTOGRAPHY AS A HOBBY



IN 1917, HE ENLISTED IN THE U.S. ARMY SIGNAL CORPS. HIS PHOTOGRAPHIC SKILL WON HIM A LIEUTENANT'S COMMISSION IN A FEW MONTHS



LATER, OUTSTANDING WORK IN FRANCE MADE HIM A CAPTAIN AND CHIEF PHOTOGRAPHIC OFFICER FOR THE FIRST ARMY, A.E.F.



FOLLOWING THE ARMISTICE, HE PHOTOGRAPHED THE BATTLEFIELDS OF EUROPE FROM THE AIR



WHILE MAKING AERIAL MAPS OF ARGENTINA FOR THE NATIONAL GEOGRAPHIC SOCIETY IN 1930, HE OBTAINED THE FIRST PHOTOGRAPH TO SHOW THE CURVATURE OF THE EARTH

THE CAREER OF MAJOR A. W. STEVENS



7 HIS INITIAL ASCENT INTO THE STRATOSPHERE TOOK PLACE IN 1934. AT THE PEAK OF THE FLIGHT, HIS BALLOON WAS 60,600 FEET ABOVE THE EARTH



8 THROUGHOUT THE ASCENT, MAJOR STEVENS WAS BUSY MAKING SCIENTIFIC OBSERVATIONS



9 AS THE BALLOON DESCENDED, IT BURST IN MID-AIR. MAJOR STEVENS AND TWO COMPANIONS BAILED OUT IN PARACHUTES



10 AS A RESULT OF HIS AERIAL EXPLOITS, MAJOR STEVENS HAS BEEN HONORED BY SCIENTIFIC SOCIETIES, EDUCATIONAL INSTITUTIONS, AND THE U. S. GOVERNMENT



10 THE FOLLOWING YEAR, IN ANOTHER BALLOON, HE REACHED THE RECORD ALTITUDE OF 72,395 FEET

B. W. SCHLATTER

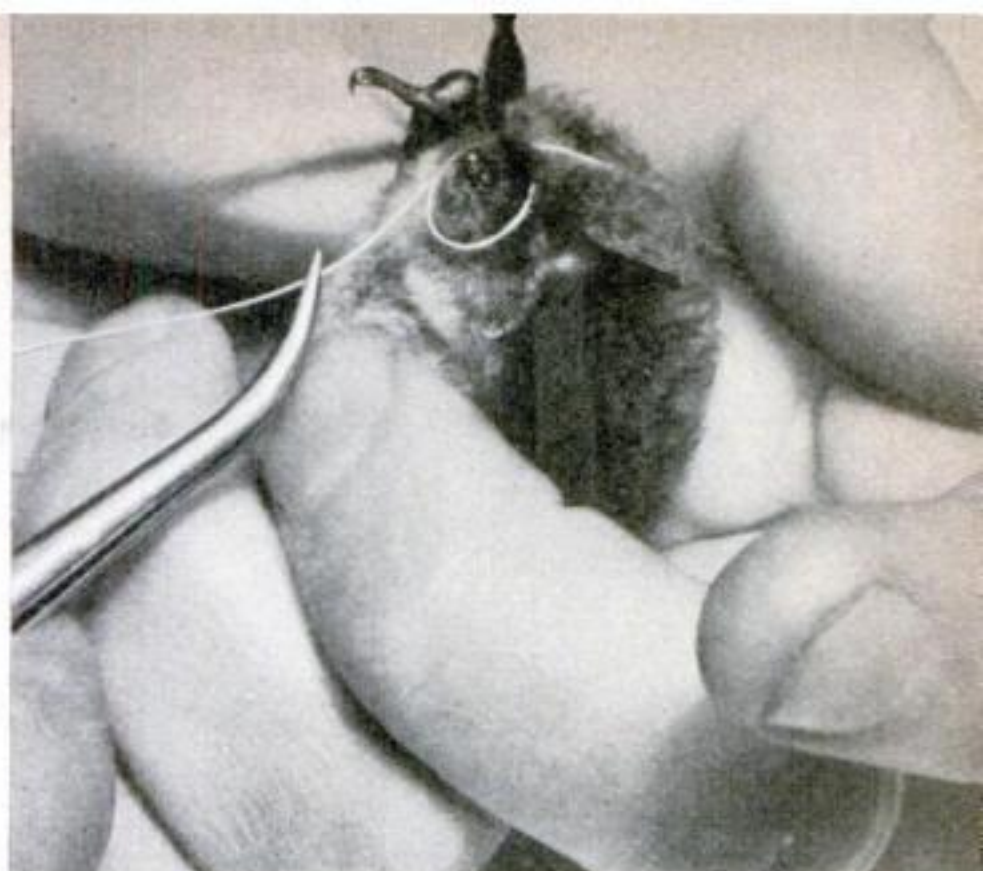
How Bats "See" in the Dark

*After Nearly 150 Years of Experimenting,
Science Solves the Riddle of Night Flight*





Placing a glass tube in a bat's ear. By inserting cotton plugs, experimenters proved that hearing plays a part in bats' ability to "see" in the dark



To show that "inaudible" sounds normally uttered by bats help to guide them, this fellow is being gagged with thread and collodion

By **EDWIN TEALE**

TEN THOUSAND experiments in a soundproof laboratory at Harvard University have just enabled two young scientists, Robert Galambos and Donald R. Griffin, to solve the mystery of how bats avoid objects in the dark, a riddle that baffled research workers for a century and a half.

The delicate supersonic detecting device they used in their experiments reveals that bats always give off a continuous series of shrill cries during flight, cries so high-pitched that they are inaudible to human ears. Echoes of these "silent sounds," reflected from obstacles ahead, warn the animals when to veer aside. Bats, thus, "see with their ears," guiding their course through the darkness of caves and woods by means of a natural counterpart of the sonic depth-finder, the apparatus which enables mariners to measure the depth of the sea by means of echoes reflected from the ocean floor.

It was Dr. George W. Pierce, eminent Harvard physicist and inventor, who supplied the clew. His supersonic detector, changing "silent" sounds into audible ones, opened up a whole new realm of research. In 1938, the Pierce mechanism proved that bats emit sounds we cannot hear. That put Griffin and his collaborator, Galambos, on the right track.

At the Harvard Physics Laboratory, steel wires, eventually reduced in size until they

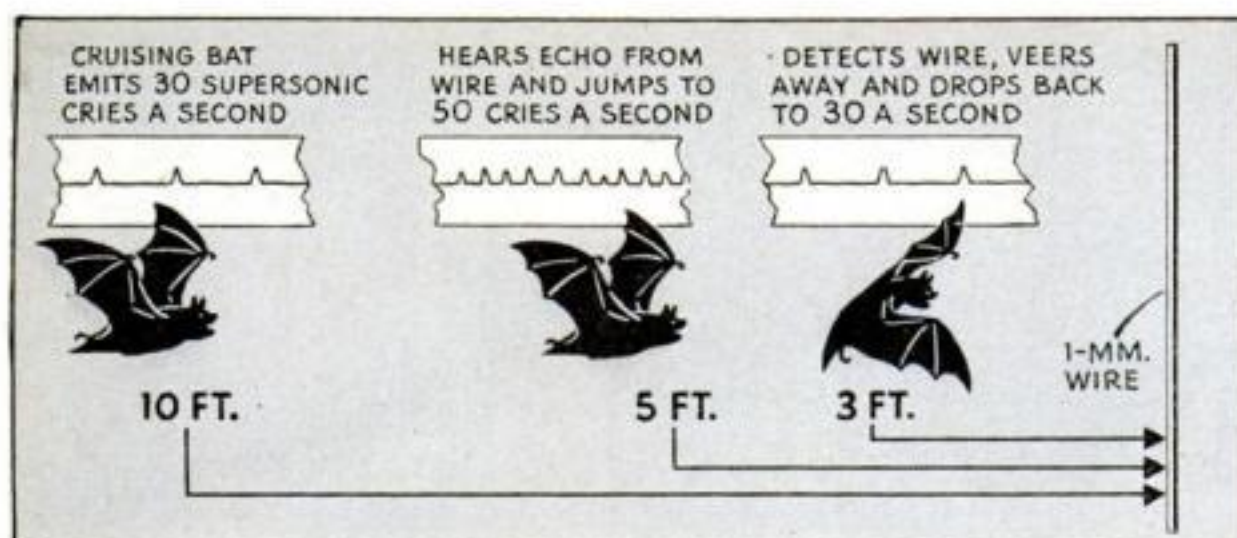
Like a racing plane, a bat banks for a sharp turn. This picture, one of the most remarkable bat photographs ever taken, was made by Prof. Harold E. Edgerton of the Massachusetts Institute of Technology. His ultra-high-speed flash camera caught the animal in full flight. Exposure was 1/100,000 of a second



The opaque collodion solution was also used to "blindfold" the animals in other tests. After the experiments, the bats were as good as new

were only one millimeter thick, were stretched from floor to ceiling of a room. Two hundred little brown bats successively swooped and zigzagged about. The instant they took wing, the supersonic detector began to chatter. The bats gave off approximately 30 cries a second in the sound-wave band between 30,000 and 70,000 vibrations a second. Human ears have a top limit of about 20,000.

When one of the flying animals approached within ten feet of a wire, the staccato volley jumped to 50 cries a second. Then, it suddenly tapered off again to 30 cries and the bat, flying at its normal speed of about five feet a second, shot to one side



How the Pierce supersonic detector records a bat's reactions on approaching a wire in tests

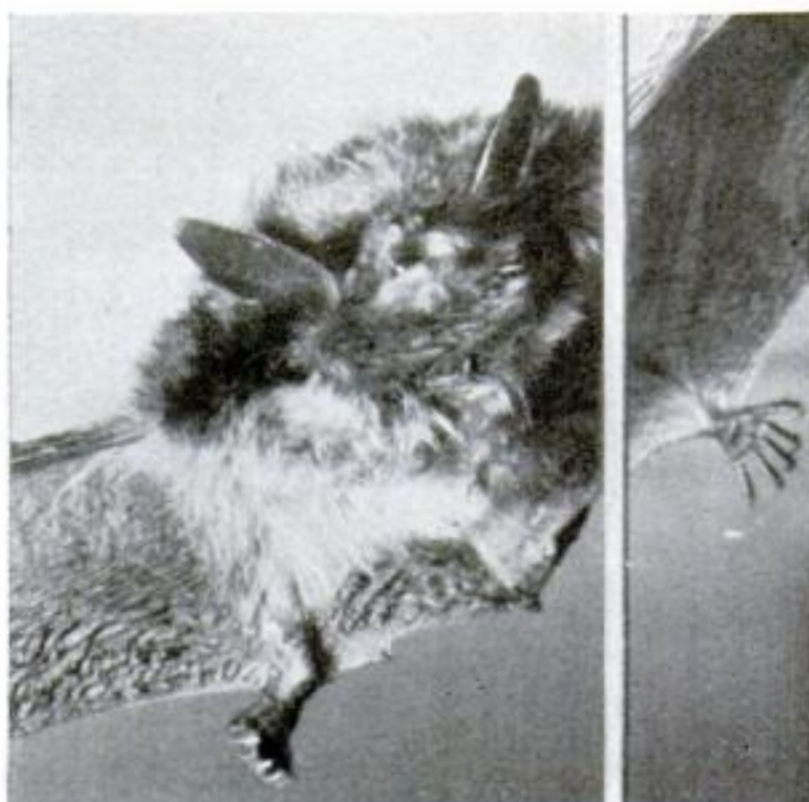
Below, relative sizes of bat and one-millimeter wire its "depth finder" can detect while flying

and avoided the obstacle. What appeared to happen was this: When the bat approached the wire, its delicate ears caught faint echoes. The quick burst of faster cries, also echoing back, gave it the exact location of the wire and enabled it to swing to one side. That, at least, was the theory of the experimenters. To prove it conclusively required nearly a year of concentrated research.

First, Galambos and Griffin ran hundreds of tests with normal bats. They found that their wings came in contact with the wires of the laboratory maze about 25 times in every 100 trials. When the animals were blindfolded with an opaque collodion solution, their average remained the same. But when tiny glass tubes, tied in their ears, were filled with cotton batting soaked in the collodion solution, the number of hits in a hundred trials zoomed from 25 to more than 65. Then the cotton plugs were removed. The score dropped back to a normal 25. The ears of the bat, these tests conclusively proved, are vital to its ability to avoid obstacles.

There still remained the job of proving that the staccato cries given off during flight also play a part in this uncanny performance. With loops of linen thread, the scientists tied shut the mouths of the bats and sealed their lips with collodion solution. The animals immediately began banging into wires and blundering about the room, making as poor a showing as when their ears were plugged. When the threads were untied and the collodion removed with ether, the bats darted about, avoiding the wires as usual.

By the use of sound-recording and high-speed motion pictures, Galambos and Griffin have produced reels that record the action of the bats and the sounds they produce at each point during flight. These reels, together with the other data of the Harvard investigators, have succeeded in erasing another of the question marks of science, revealing the simple but amazing explanation of how bats "fly blind."



Robert Galambos, one of the experimenters, "tuning in" bat cries on the Pierce detector, which makes the supersonic vibrations audible to the human ear



Ludwig Wonkow's heated knife blade made this out of a candle

Just an Ordinary Candle Is Sculptor's Material

COMICAL figures can be "carved," with a minimum of effort, from ordinary candles, according to Ludwig Wonkow of New York City. One candle for each figure, a few matches, pins, toothpicks, and a pocket knife with a constantly heated blade make up the list of tools and accessories needed. The candle wax literally melts under an artist's fingers, and can be twisted and shaped to grotesque forms before it cools. Pins with large black heads form eyes, and matches or toothpicks serve as canes, guns, or whatever your fancy may dictate. A hobbyist at the odd craft, Wonkow draws on additional "props" for candle-wax figures such as the one illustrated in the photograph at left. Dripping wax is shaped with the hands while it is still warm and soft.

Passengers Listen to Radio As They Ride in Elevator

RADIOS entertain elevator passengers, probably for the first time, in a large Philadelphia office building. Push buttons in the car operate its speaker by wired remote control of a receiver with a loop antenna at the head of the shaft, over standard elevator cable.



It's "What program, please?" as well as "Floors, please" on this elevator. At left, the operator selects a station to entertain his passengers, and, above, a girl shows where the music comes from

VOOMP CLANK BONK

*Name Your Noise and the Movies'
Sound Makers Will Give It to You*



SERIOUS-MINDED musicians in the Walt Disney studio look at a picture of Donald Duck falling into a lake on a three-legged motor cycle and agree: "What we need for the sound track there is a loud 'voomp!'"

They eye another comedy sequence, in which a six-cylinder engine is popping off, and realize it would be even funnier if they could make each cylinder give out a different sound.

As they stare at more pictures, they fret about how to make a noise to match a bed spring bursting through a mattress, how to enchant the audience's ears with the anguish of a train chugging up a grade, to simulate a auto crash.

They conquer all these problems, and their reward is in knowing that movie-goers

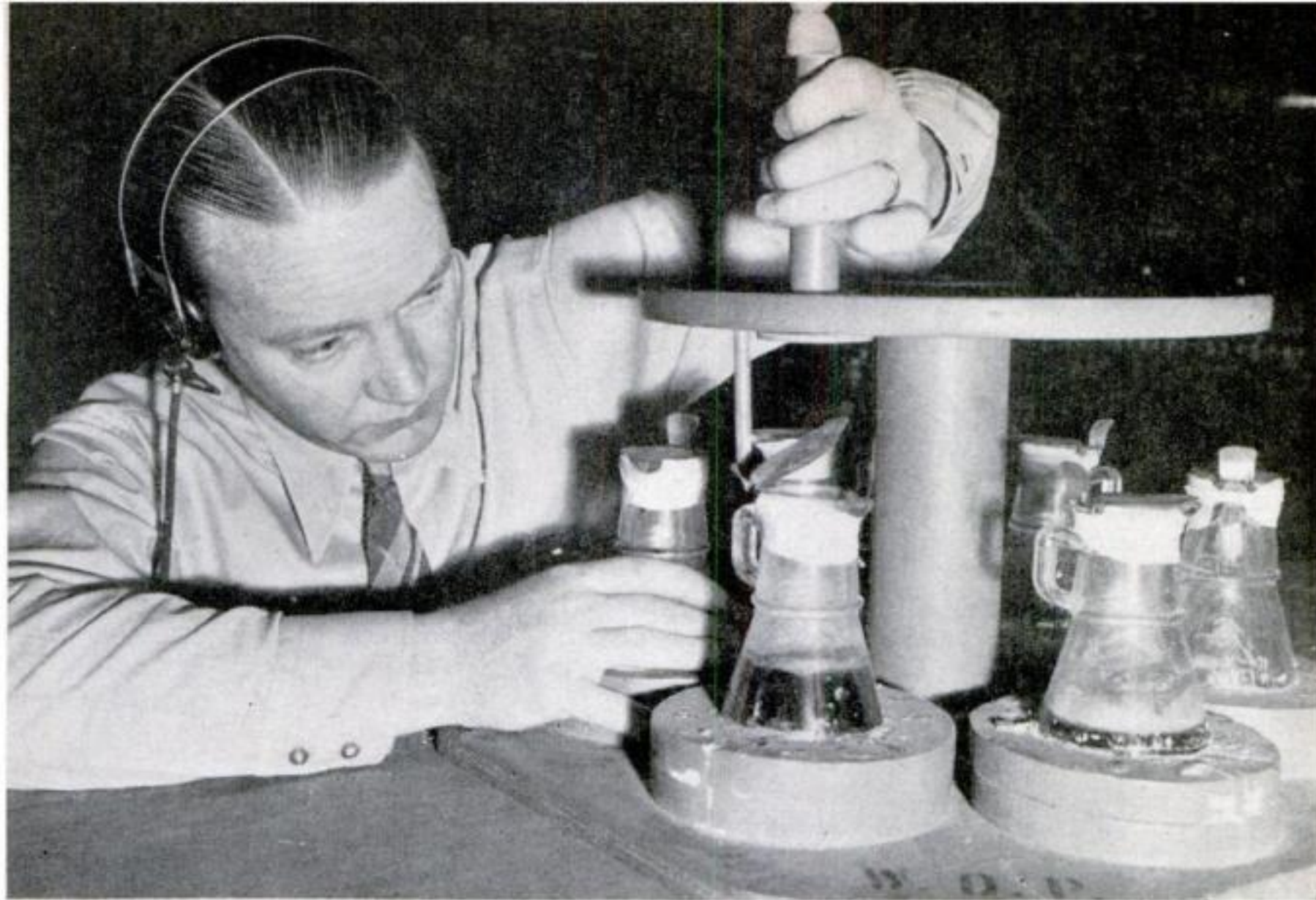
Queer Sounds Director Hal Reese directs the making of a "voomp," simulating the sound of Donald Duck's motor cycle plunking into a lake. At right, the plunger smacks the suds



will laugh as much at the noises as they do at the antics of the cartoon characters.

That "voomp," for instance. Lesser artists might have been satisfied with, say, a "blorp." Or with a "squoph." Not Disney's noise trust. They said it *must* be "voomp." Their only trouble was that "voomp" wasn't among the hundreds of crazy sounds they have catalogued.

The noise-trusters were Hal Reese, who played two years with the Los Angeles



This contraption makes the exhaust noises for a comic six-cylinder car. As the disk is revolved, a pin strikes the lids of six sirup pitchers, opening them and clopping them shut

Symphony Orchestra, and Clyde "Rusty" Jones and Eddie Forrest, who have played with dance bands. And they were busy hunting that "voomp" when this observer came along.

They were standing around a concrete bathtub, four feet wide, five feet deep, and ten feet long. In it were 1,400 gallons of water. Rusty had on a raincoat and a rain hat. He stood over the tank holding a plunger resembling an inverted light-globe cover. Forrest was in charge of controls which separately let steam into the tub and dumped liquid soap into it. Reese, baton in hand, was behind the plate-glass window of a sound-control booth, ready to listen in through loudspeakers.

"Hit 'er a lick," said Reese. Jones smacked his plunger into the tank. "Plunk," came the sound. "Not right," said Reese. "Give her more soap." Forrest emptied a gallon of liquid soap into the

tub. He poured in some soap flakes. That made 25 pounds of flakes and three gallons of liquid soap in the mixture.

"Hit 'er again," said Reese. Down came the plunger. And, as the faces of the three musicians filled with ecstasy, out came an enchanting, an astonishing, an ear-filling "voomp!"

"Swell," said Reese. "We'll record the next one. Go on the fourth beat." Reese



Once this expert was hurt when the shot-filled rubber ball for making surf noises burst. He plays safe now, wearing a helmet

directed his musical assistants. Jones took his position again. On the fourth beat, down came the plunger. This time the "voomp" scattered suds 20 feet in all directions. This time, too, the sound was recorded that will make you laugh when you see Donald Duck careen into the lake on his motor cycle.

That's just one of the sounds the noise masters have manufactured.

One morning Reese and Earl Hatch of the Disney sound crew were sitting at breakfast over hot cakes and sirup, wondering how in the world they were going to make a six-cylinder engine give off different sounds for each piston. They were in despair. Thought it couldn't be done. About to give up, both toyed abstractedly with their sirup pitchers. Suddenly Hatch heard rhythm and became aware that his pitcher top made a different sound from that of Reese's. "That's it!" he shouted.

They grabbed up six pitchers and ran back to the studio. They graduated the levels of sirup. They devised a gadget to flip the pitcher tops up and down. And that afternoon they had their "engine," with each cylinder tuned to individual musical pitches.

Outsiders regard the noise trust's occupation as very safe. Actually the members face danger so frequently with their dizzy inventions that their injury rate is higher than among any other movie-making group except the stunt men.

Once Eddie Forrest had the task of rattling an overinflated volley-ball bladder

with buckshot inside. That will make thunder, an explosion, the roar of a turbine engine, or high waves crashing over a sea wall, depending on how hard the bladder is shaken.

Forrest was imitating a tidal wave when the bladder burst and shot him—actually shot him. Buckshot penetrated his bare chest and a strip of rubber slashed his face from temple to chin. Now he wears a canvas mask and keeps his shirt on when waving.

That concrete tub used for the "voomp" has other purposes, too, one of them in connection with Mickey Mouse's operation of trains. At one end of the vat is a series of pipes fitted with 21 valves through which pass hot and cold water and air. By mixing the three, steamlike vapor is produced. As this is turned on and off, the sound makers produce everything from the chug-chug of a train to the snores or gasps of animals.

It takes a "buzzaphone" to create that snarling sound that is heard when an expanding bed spring tears through its mattress covering. The "buzzaphone" consists of a set of hack-saw blades arranged like a piano keyboard on two gas pipes filled with ground glass and set in a sounding board. It is played by drawing taped fingers along the hack-saw keys. To the ear, it sounds like a medium-range instrument, but when the microphone transmits the notes to a loudspeaker one hears a bass possessed of a buzzing quality. Somehow, the vibrating keys, a quantity of glass, the gas pipes, and



Playing the hand-made organ that furnishes musical chords—of sorts! Three rubber tubes lead from each of five bellows to the proper set of tuned pipes, giving three-note chords when bellows are pushed. The chords may be altered by rearranging the tubes



The "buzzaphone" is the only one of its kind in the world. It was originally developed to simulate the sound of a bed spring bursting its covering. It consists of hack-saw blades fastened to pieces of iron pipe filled with splinters of glass

the resonator chamber achieve just the desired effect.

One of the most familiar sounds to cartoon-comedy fans is that of an auto crash. It's one of the most difficult, too. Rusty Jones and Eddie Forrest play six instruments simultaneously to get that ear-shattering discord. They use tuned cowbells, a high-note horn, a tuned auto horn, a paper whistle, a popgun, and a variable-pitch drum made from a nail keg.

All the strange noises are coordinated by Reese, who looks at the noise makers from behind the window of his control booth, where he checks the balance and tempo through loudspeakers at his side. Unlike musicians playing with bands and orchestras, his musicians with their goofy gadgets must always think of the animators, busy in adjoining buildings turning out thousands of drawings on celluloid.

Each instrument, while its tones possess a quality different from those produced by standard instruments, is kept strictly in tune. That goes for a hand-made organ which plays any combination of five chords, the chords being varied by tuning wooden pipes. It is true of the metal strips, made of an alloy of aluminum and steel, which were devised to replace the dangerous glass wind bells. It applies to the set of rollers, moving around a cir-

cular track and striking six notches, which makes the clickety-clack of train wheels.

Reese thinks nothing of sitting down in the morning prepared to fit sounds to 80 photographs of scenes laid out before him on a story board.

"This calls for a 'clank,'" he says into the microphone. Or, "Our train will climb a four-percent grade in three-six time, five measures. It will ease downgrade three measures and crash through the bridge on the second beat of the tenth measure."

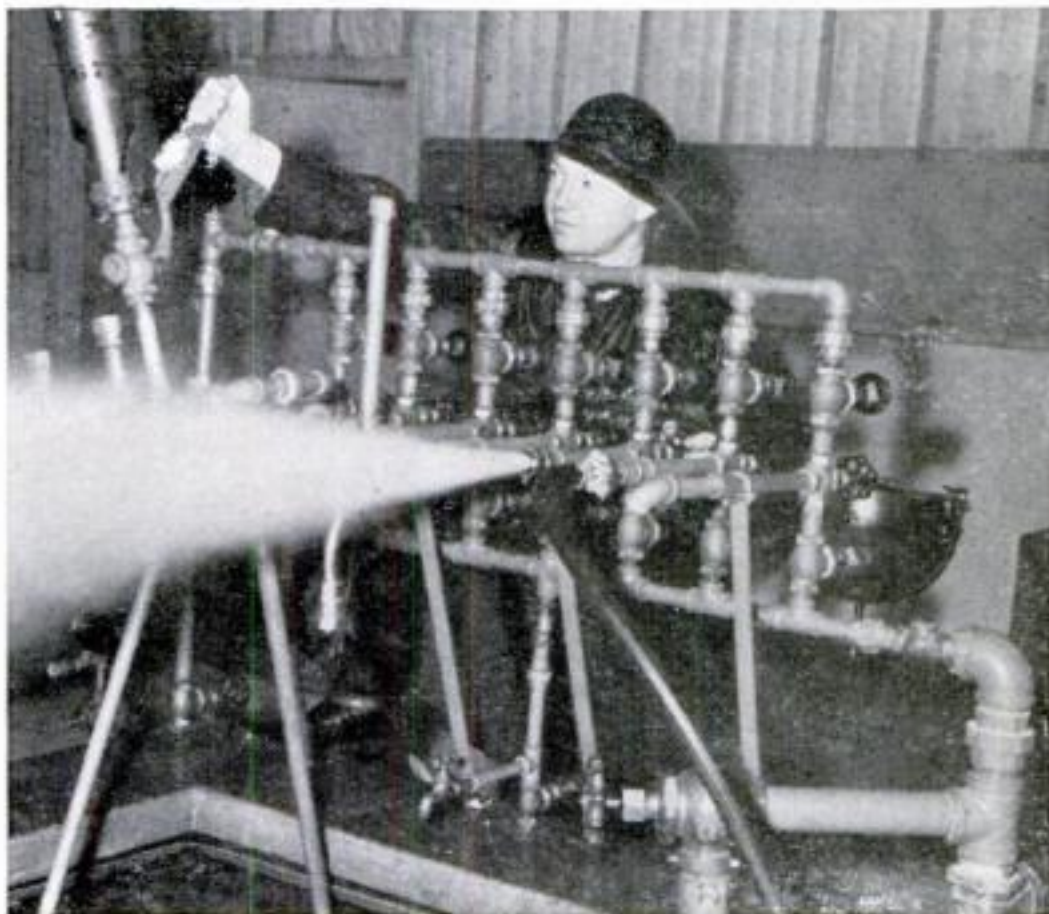
Then the day's work starts.



A pair of Disney experts bear down on six gadgets at once to create the sound of an auto crash. Below, pipes and valves that squirt water for soap suds and blow whistles



A new high in ludicrous sound is said to be achieved with this solo instrument. It is made from a trumpet mouthpiece, a drip-type coffee pot, and a plumber's friend





The Man With a Thousand Voices

By MILTON BRACKER

HARRY WELCH discovered he could do things with his voice that nobody else could, when he was a kid in P.S. 6, Baltimore, some 35 years ago. He found it out first, but his classmates were right behind. They kept him so busy imitating lions and tigers and cows and ducks that "I got throwed out of school four times." He managed to finish, however, and to do three years at a local technical high school. But he now earns his living without benefit of anything he ever was taught. Harry Welch is the voice of Popeye in the movies, and he has such a genuine affection for the rubber-jawed sailor man that he calls his three-year-old daughter Swee'pea.

Welch is not exclusively Popeye. He is often Olive Oyl, Wimpy, Bluto, and incidental Goons. He was the Big Bad Wolf in "The Three Little Pigs." He was six of the Seven Dwarfs and would have been all seven if Dopey hadn't been so dumb. He can be Donald Duck and Mickey Mouse and any of the chattering creatures of the Silly Symphonies. What's more, he can do a five-minute opera with two orchestras and five singers.

Speak not of glottises and inter-arytenoidal folds to the affable Mr. Welch, who admits he has a "larnyx" (sic) but is enormously uninterested in his own anatomy. "I don't know how the hell I do it," he says, modestly. "I just get up and do it."

Welch was born in Annapolis on Novem-



Harry Welch, the voice of Popeye, starts off his famous theme song



His huge chest cavity produces low, guttural resonance like a bass viol's



For the "beep beep" at the end, a high, resonant tone is used

"I'm Popeye the Sailor Man-Beep Beep"

ber 27, 1897, of Scotch descent. Efforts to pin him down as to the exact moment he discovered he was vocally unique are futile; he simply knows it was when he was a schoolboy and went to visit the zoo. During the first World War, when he served in France with the Fifth Infantry of the Maryland National Guard, he was much in demand as an entertainer. Once they took him from the front lines to Paris for two weeks; he entertained Albert, King of the Belgians, and Generalissimo Armando Diaz of the Italian Army. Back at the front, he got a shrapnel wound in the left hip, but "I entertained all the fellas in the hospital." Just fourteen years later, he did the same for King George V of England at Buckingham Palace.

But immediately after the war, he went

back to business: selling rugs for a Fifth Avenue wholesaler. He did imitations for his customers. "That's how I used to get business. They'd hear me and say, 'Is that guy in again? We'll have to give him an order to get rid of him.'"

Welch liked the rug business, but a wider public called. He did not create the screen voice of Popeye (that was the work of Billy Costello) but took it over in 1934, and last year handled the part in ten of fourteen Popeye shorts. The sailor man originates vocally at Welch's navel or thereabouts, and the tone stays at that level except when Popeye goes into that peculiar rapid-fire mutter that is his own particular kind of double-talk. That comes in a sort of

"Oh = Popeye"



The romantic Olive Oyl owes her shrill falsetto to Welch's ability to shorten his vocal cords like the strings of a violin



jumbled whisper from Welch's mouth; his navel has nothing to do with it.

"You can do Popeye on a full stomach," he says, "but that's as far down as you can go." The Big Bad Wolf, for example, would require some preliminary fasting. "Why, you three little runts in there," he roars abruptly, his abdomen making strange palpitations and his elastic jaws working furiously, "I'll huff and I'll puff and I'll BLOW your house down." Then, instantaneously, a scared little pig: "Holy gee, can you imagine that big guy out there..."

He doesn't do Donald Duck professionally but can do Donald to the satisfaction of any audience. Donald, says Welch, combines five sounds in one, roughly combining Popeye, Olive Oyl, Wimpy, and a couple of other guys. Welch is never better than as Donald under water, or in any circumstance where the famous gluggle-gluggle-gluggle is called for. He seems to bounce the sound from one of his laterally distended jaws to the other; it emerges more like a gargle than anything else, but don't try it with your favorite mouthwash in the morning. Another *tour de force* is his rendition of the original organ at the Roxy Theater. To produce its throbbing tones he uses his whole body; one major quiver originates at his ankles and like a wave, travels up his trousers all the way to his mouth.

Welch says that if he looks in a mirror while stripped to the waist, he can see telltale contortions while he practices. But "I don't feel anything—it just comes to me natural. I have the control of my stomach and all the sounds come from the stomach. And that's why my throat's held up all the time." He means that he's never had any throat trouble; may gargle once a day with a teaspoonful of plain olive oil, which he swallows after the last gargle, but that's all. The only tangible physical sign of his work has been the enlargement of his neck. His collar size used to be 14½; now it's 16 and sometimes that seems too small. His



"Thank you too much, Miss Oyl, but I prefer a hamburger." As J. Wellington Wimpy, the voice gets deep and throaty



Enter the Big Bad Wolf. Welch can do this one only on an empty stomach. His jaws work furiously, abdomen quivers



A one-man opera company, he can do a five-minute version of "Rigoletto" with a cast direct from the Metropolitan

normal voice is even and only fairly deep, with a looseness, as of a man with a phlegmy throat.

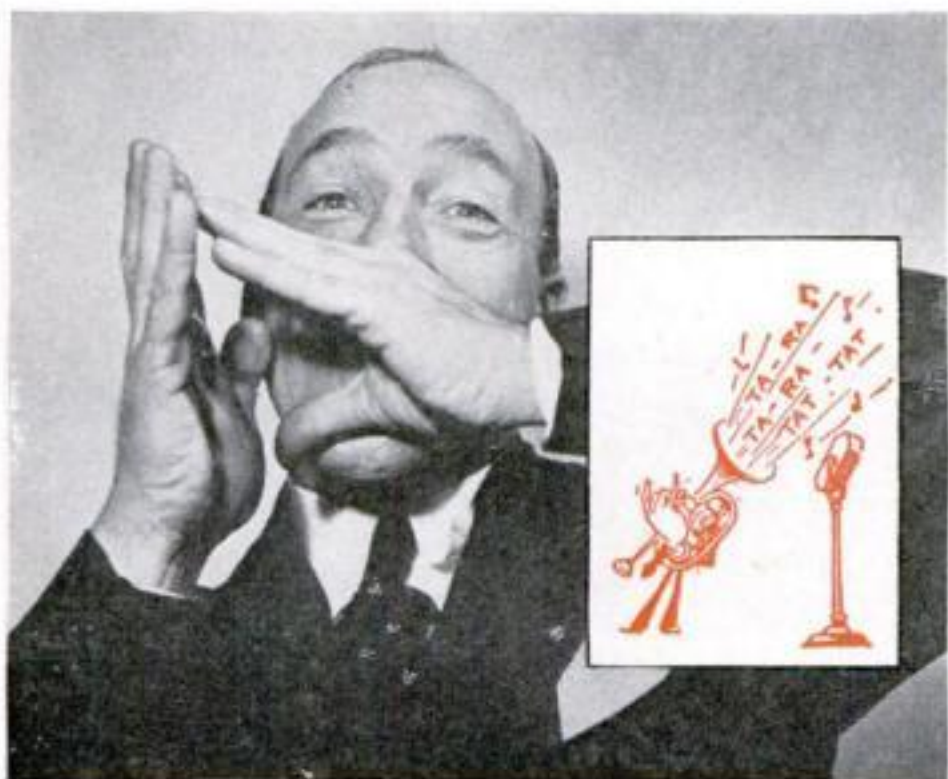
At a private party—like one last year in honor of Giovanni Martinelli—he will be introduced as a “world-famous baritone,” and come on singing “I’m Popeye the Sailor Man.” He will say he’s brought the combined Metropolitan and Chicago orchestras with him, turn and say, “Boys, come in!” Then, at a fancied podium, he will tune up. From his belly will come the resonant strokes of the bass viol. The fiddles originate higher up. His mouth narrows to a slit with clamped teeth as he brings in the oboes. And somewhere, high in his throat, form the shrill notes of a lone piccolo player. The tuning dies away. He taps with an imagined baton. And there follows a five-minute version of “Carmen,” with “Tibbett, Pons, DeLuca, and Lucy Monroe,” or any stars he chooses as his cast for the evening.

But you don’t get to hear Welch’s normal or operatic voices very often. For plainly, his heart belongs to Popeye. Thus all of a sudden:

“Well, blow me down, holy gee, here I am again, your ol’ friend Popeye, an’ I’m now gonna performorate. But foist, for wim, wigor, an’ witaliky, where is me spinach?”



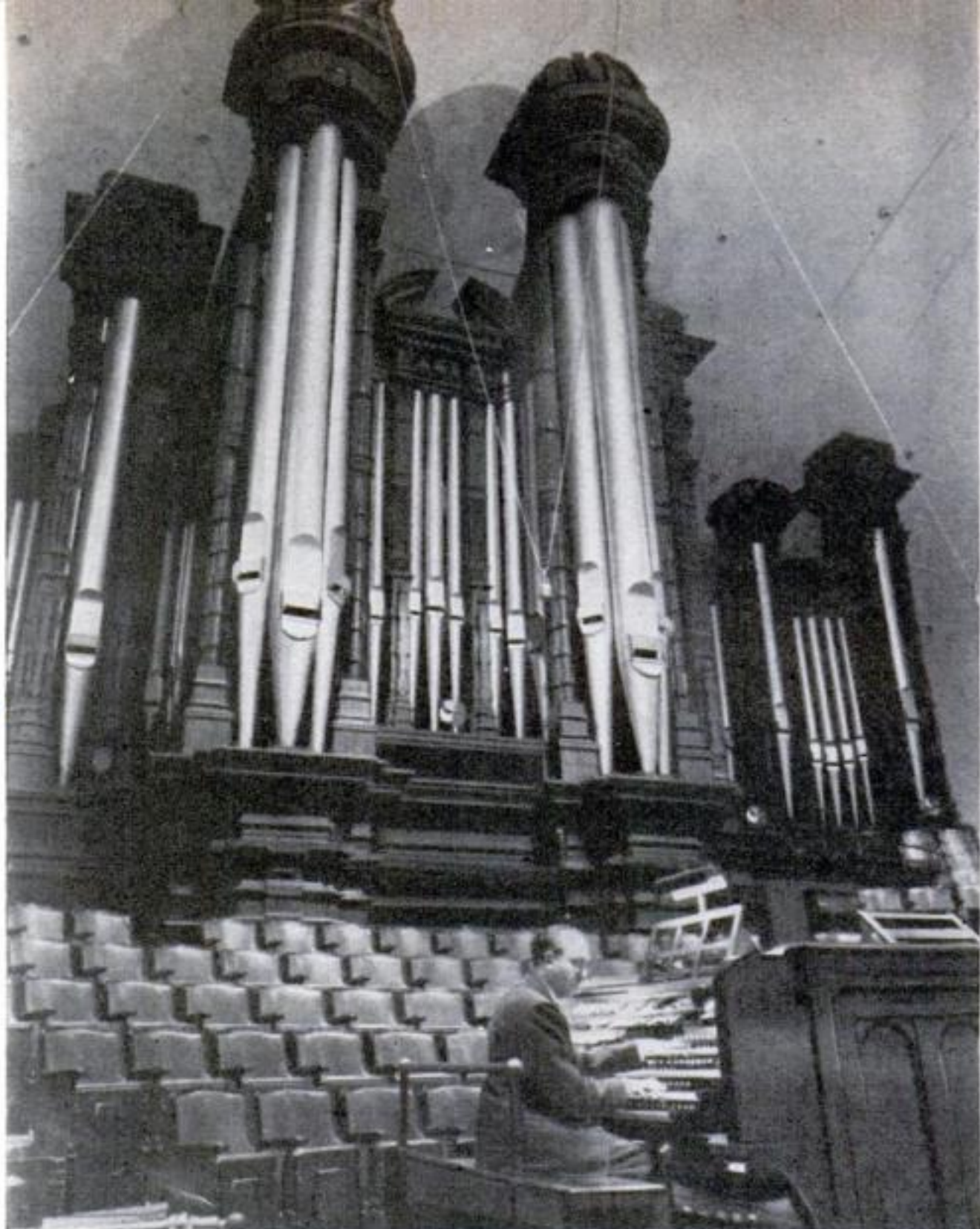
Welch’s version of a dive bomber makes you want to duck for a shelter. It starts with a high nasal resonance, then seems to swoop downward as vibrations sound from the chest cavity



He uses his hands as valves in imitating a trumpet. A favorite stunt is to tune up a whole orchestra

When he turns himself into a pipe organ, a quiver starts at his ankles and travels up into his mouth

Famous Organ Gets A New Voice



Alexander Schreiner, noted organist of the Mormon Tabernacle, strikes a key to sound one of the pipes as a guide to . . .

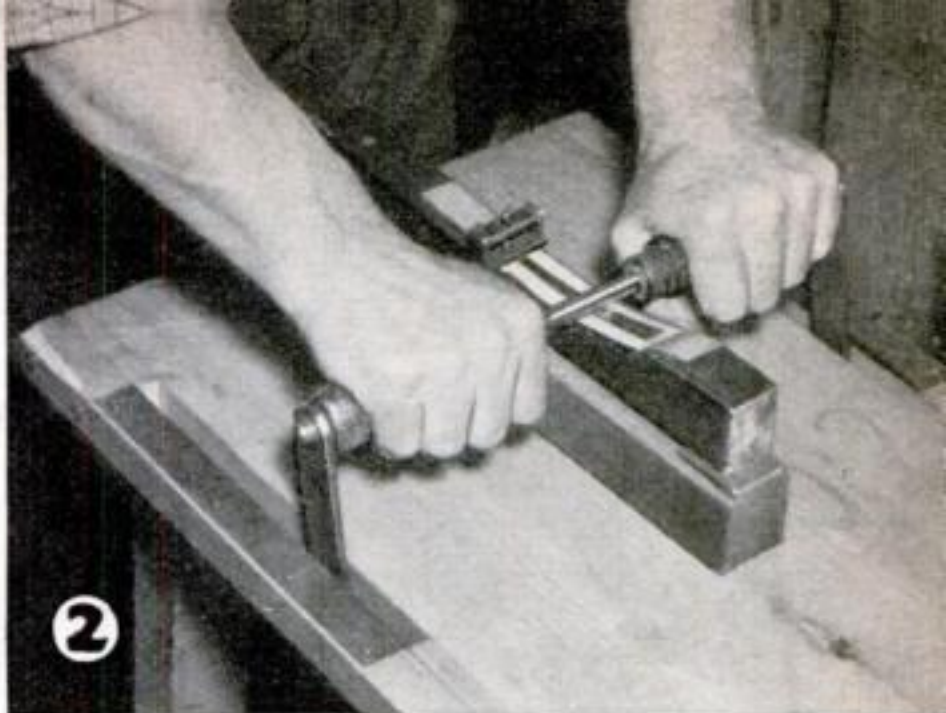
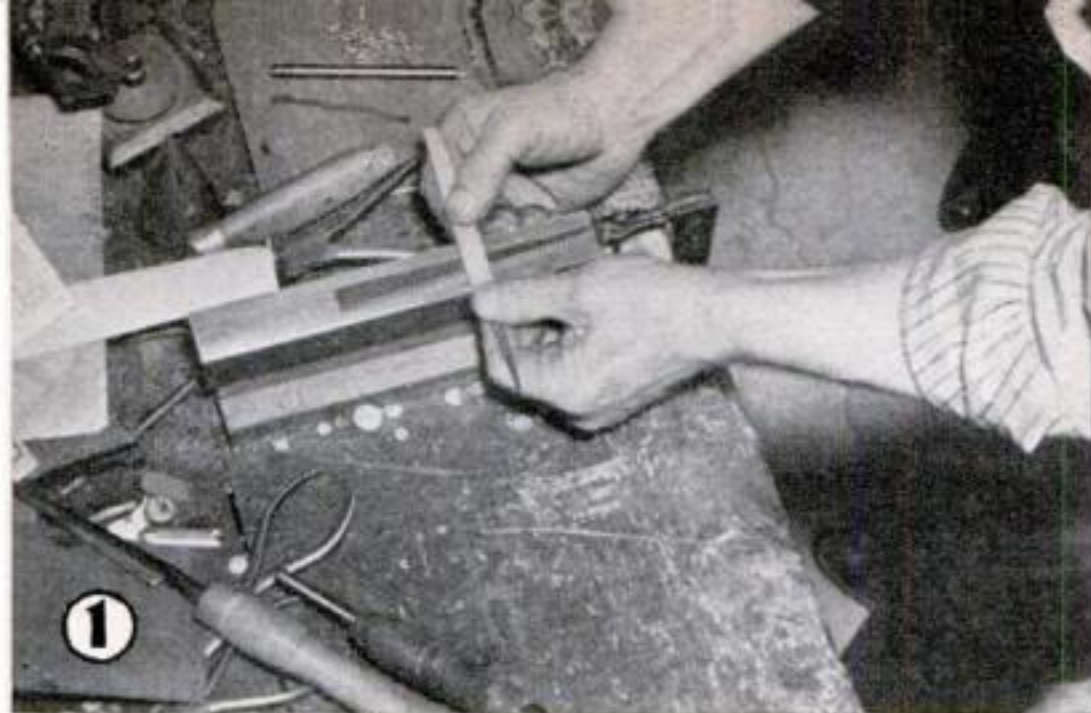
FAMILIAR to radio listeners from coast to coast, the great organ in the Mormon Tabernacle at Salt Lake City, Utah, is getting a new voice. New reeds will modernize the famous old instrument, and its 6,868 pipes will be increased to 8,000.

Nearly as well known as the organ, the craftsman in charge of this enormous task is James H. Nuttal, of Glendale, Calif. One of his most important duties is to shape the brass reeds to just the proper curve, and to tune each pipe by adjusting a wire spring that lengthens or shortens the vibrating part of the reed. This gives it the proper pitch. Other delicate adjustments consist of regulating the volume of the pipes, which range in length from five eighths of an inch to 32 feet.

. . . James H. Nuttal, who is inside the organ adjusting its tone volume. The metal pipes shown here are of zinc, lead-tin, and pure tin

The six largest pipes are the only ones of their kind in the world, being built up of glued-together sections in circular form. They sound a pitch considerably below the lowest note on the piano, producing the barely audible musical tone of 16 vibrations a second. Acoustical properties of the building's roof, likened to the sounding board of a violin, enhance the majestic tones.





1 Here Nuttal is finishing a brass reed with a flat file, after having cut it in a vise of his own design and used a wood plane on its edges

2 The most important step in pipe-organ reed construction. Pressure gives the proper curve to a reed lying on an ironwood block

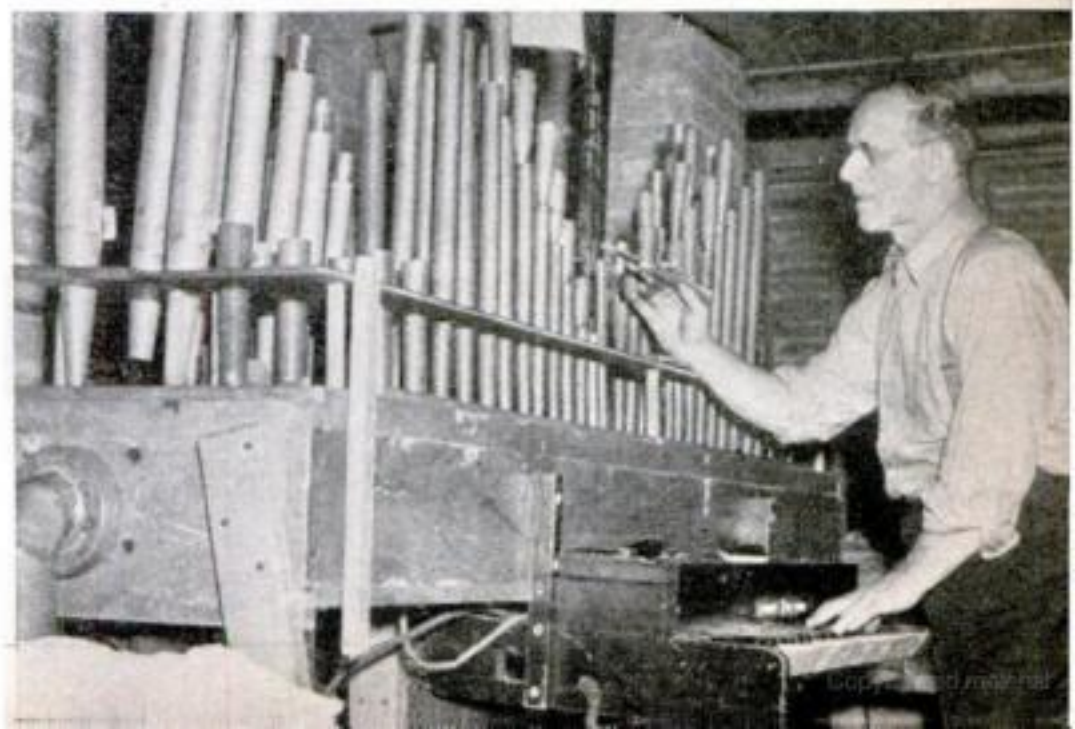
3 The finished reed is placed in the pipe block. Its vibration rate is governed by the position of the wire which is fitted against its base

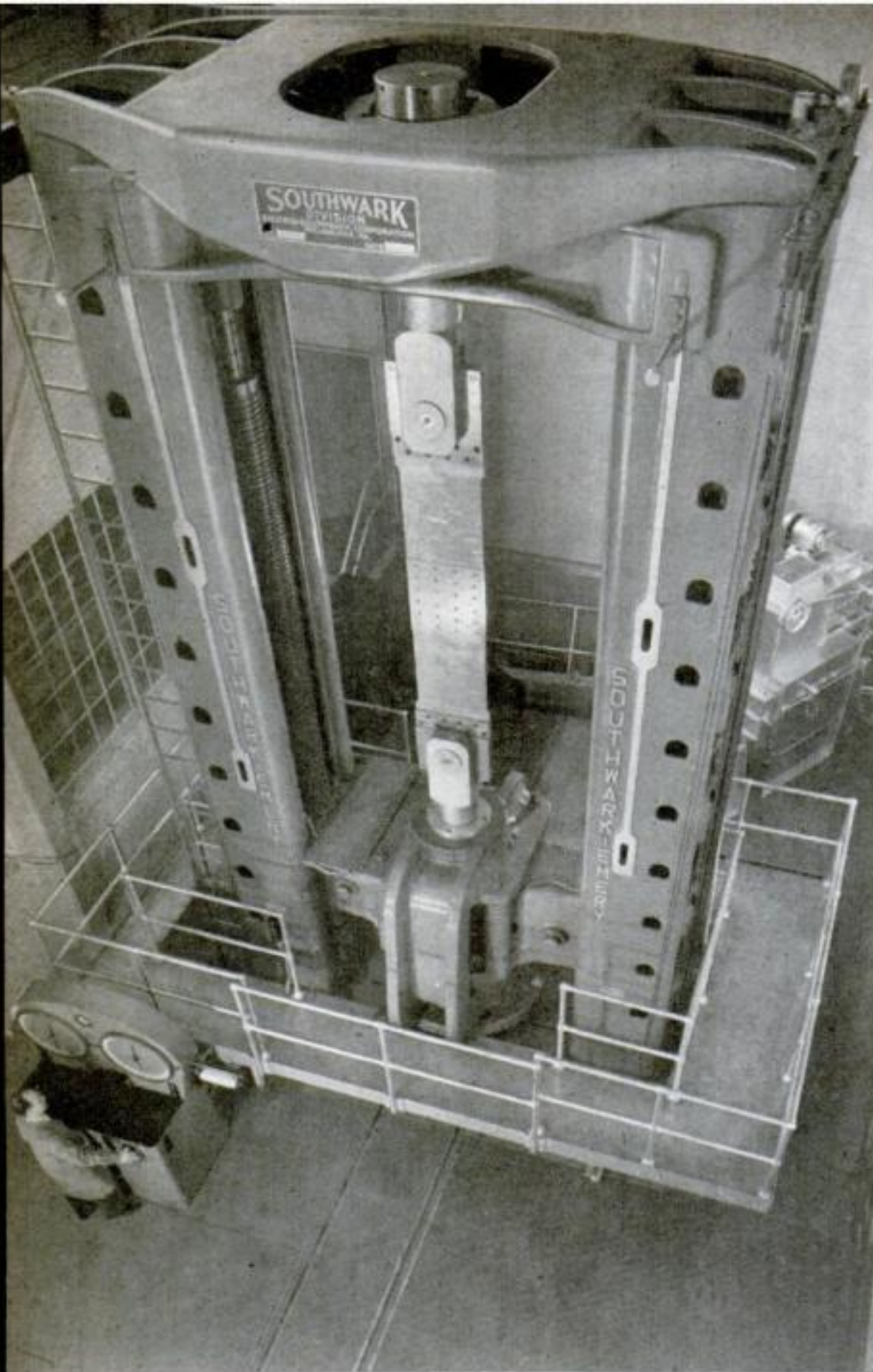
4 Nuttal now inspects the reeds in the pipes of the clarinet, flute, and violin sections for grime, insects, and the effects of wear



The top of one of the six 32-foot wooden pipes whose tone is below the lowest note of the piano. There are no other pipes like these in the world

Below is the revoicing machine, in which pipes of all kinds may be fitted for adjustment. Its chief parts are air chambers and a small organ keyboard





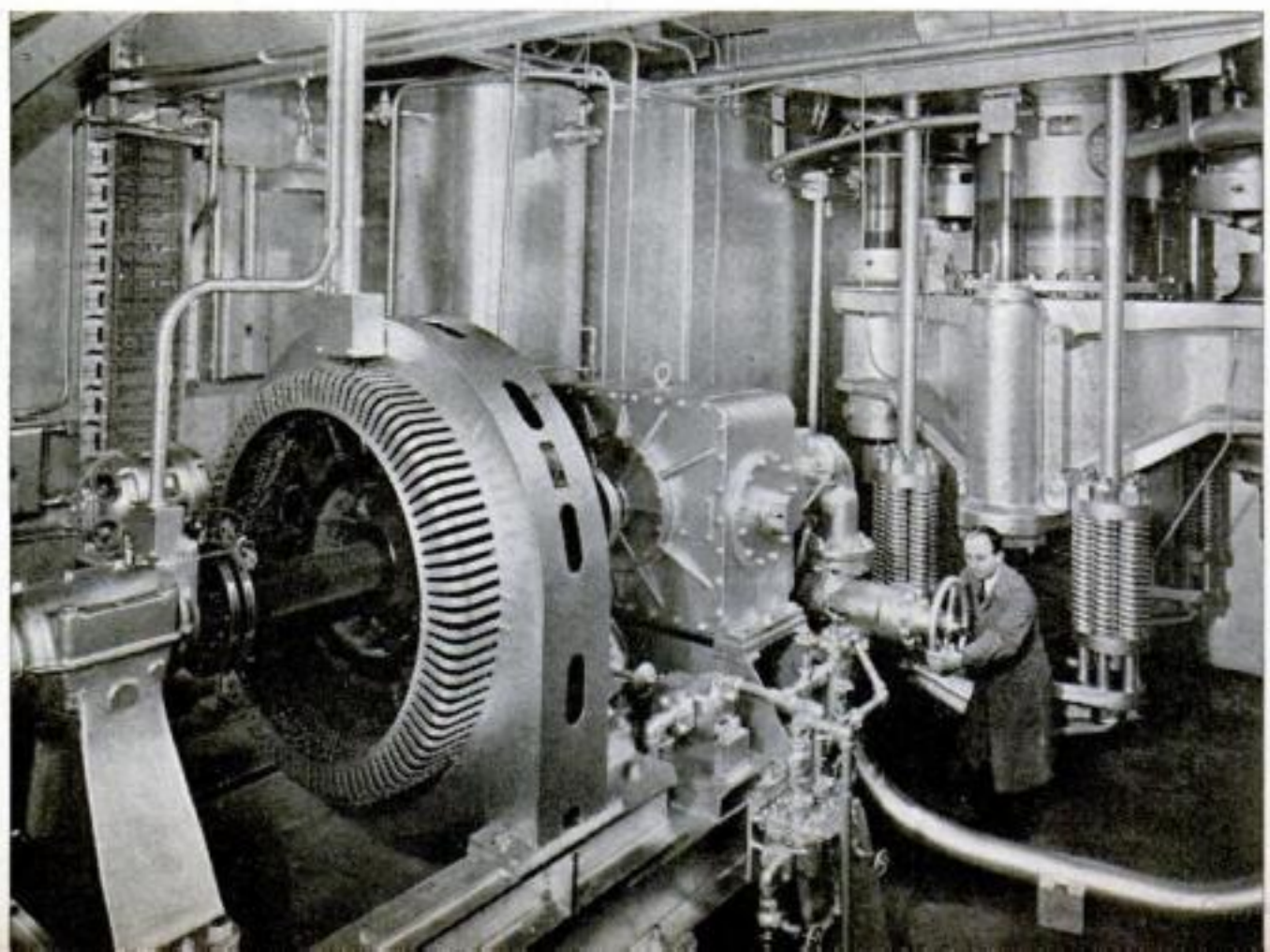
Machine Named for a Man

PUTTING pennies on a railroad track, to watch trains flatten them, used to fascinate a Kansas boy named Dick Templin. Today, as chief engineer of tests for the Aluminum Company of America, he presides over the world's most powerful crushing engine of its kind.

Named after him, the Templin precision metal-working machine stands three stories high in a research laboratory at New Kensington, Pa. With its titanic compressing force of 3,000,000 pounds, he squashes ingots of solid metal, or squeezes them through holes in dies like so much macaroni. When he puts his machine in reverse, its 1,000,000 pounds of tension tear apart heavy jointed plates, to the explosive tune of popping rivets. Yet it is so gentle that it can tap a watch and crack the crystal without damaging the works.

The huge Templin metal-testing machine, viewed from a crane in the laboratory at New Kensington, Pa. A part of its 40-foot height is hidden beneath the floor

This is the basement power plant, with the 300-horsepower motor and oil pump that power the hydraulic ram in the background. In the high-speed tests, 270 gallons of oil a minute are delivered at a pressure of 1,800 pounds to the inch

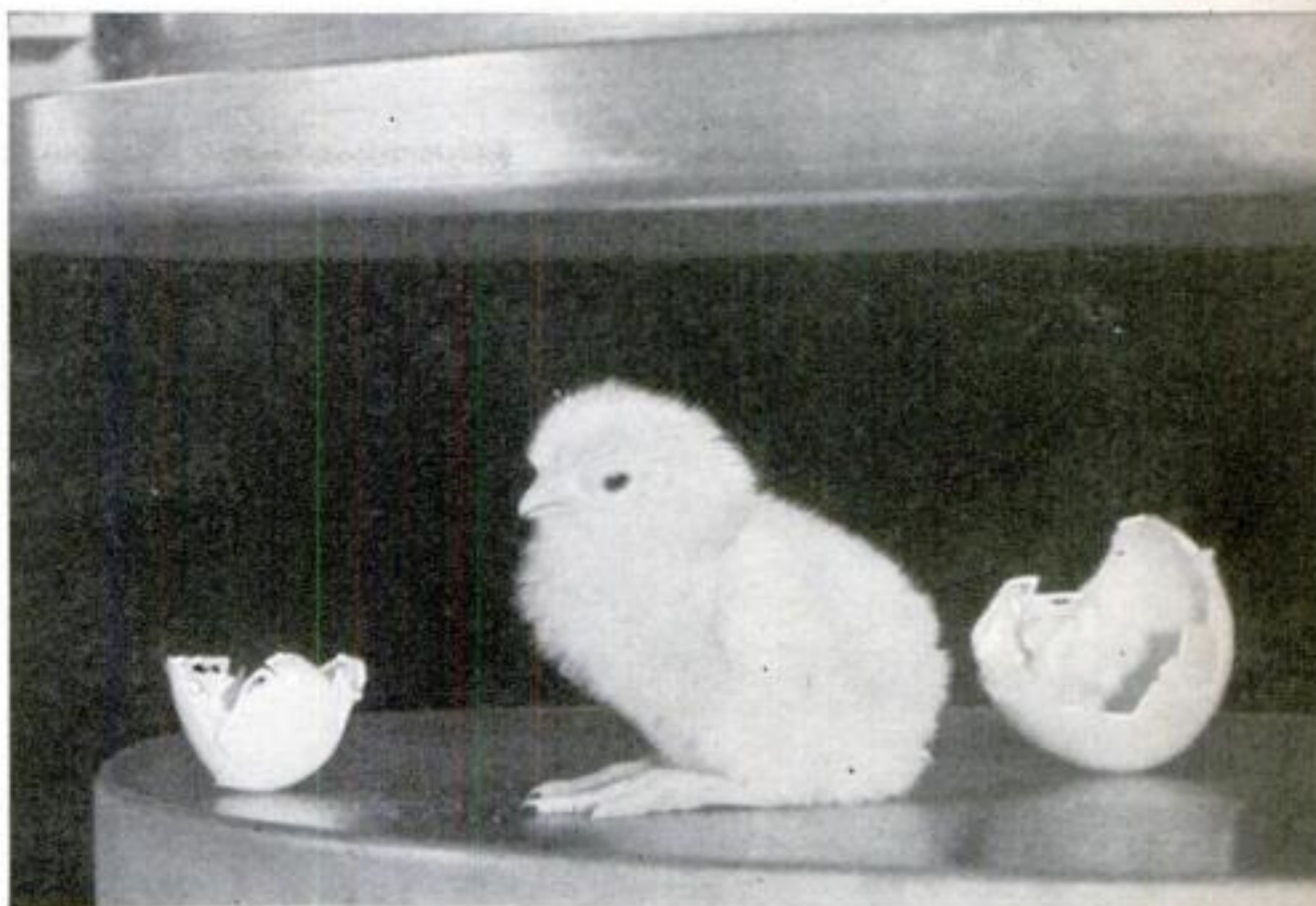


At speeds up to the unprecedented rate of 36 inches a minute, a hydraulic ram drives the business end of the machine against a test specimen. Thus the Templin tester not only yields fundamental physical data about aluminum and its alloys, such as slower machines could not obtain, but for the first time, it closely simulates what actually happens to the metal in high-speed forging presses, extrusion presses, and rolling mills. Simultaneously, precision gauges and recording meters register practical figures that help improve existing commercial metal-working machines, or create entirely new ones.

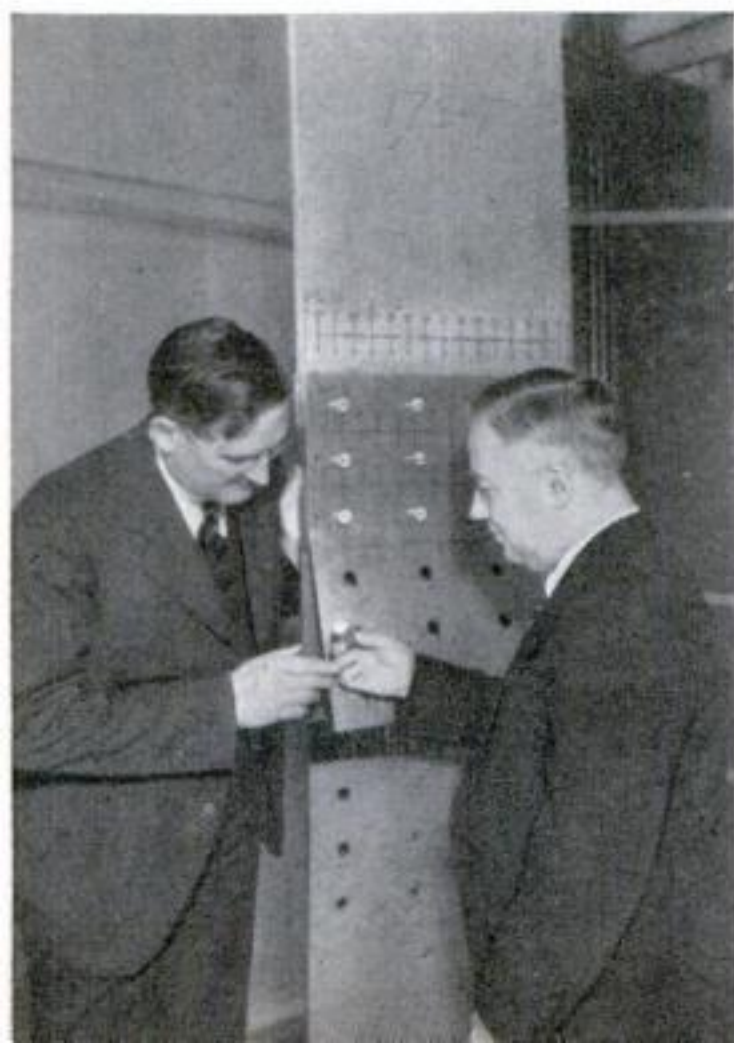
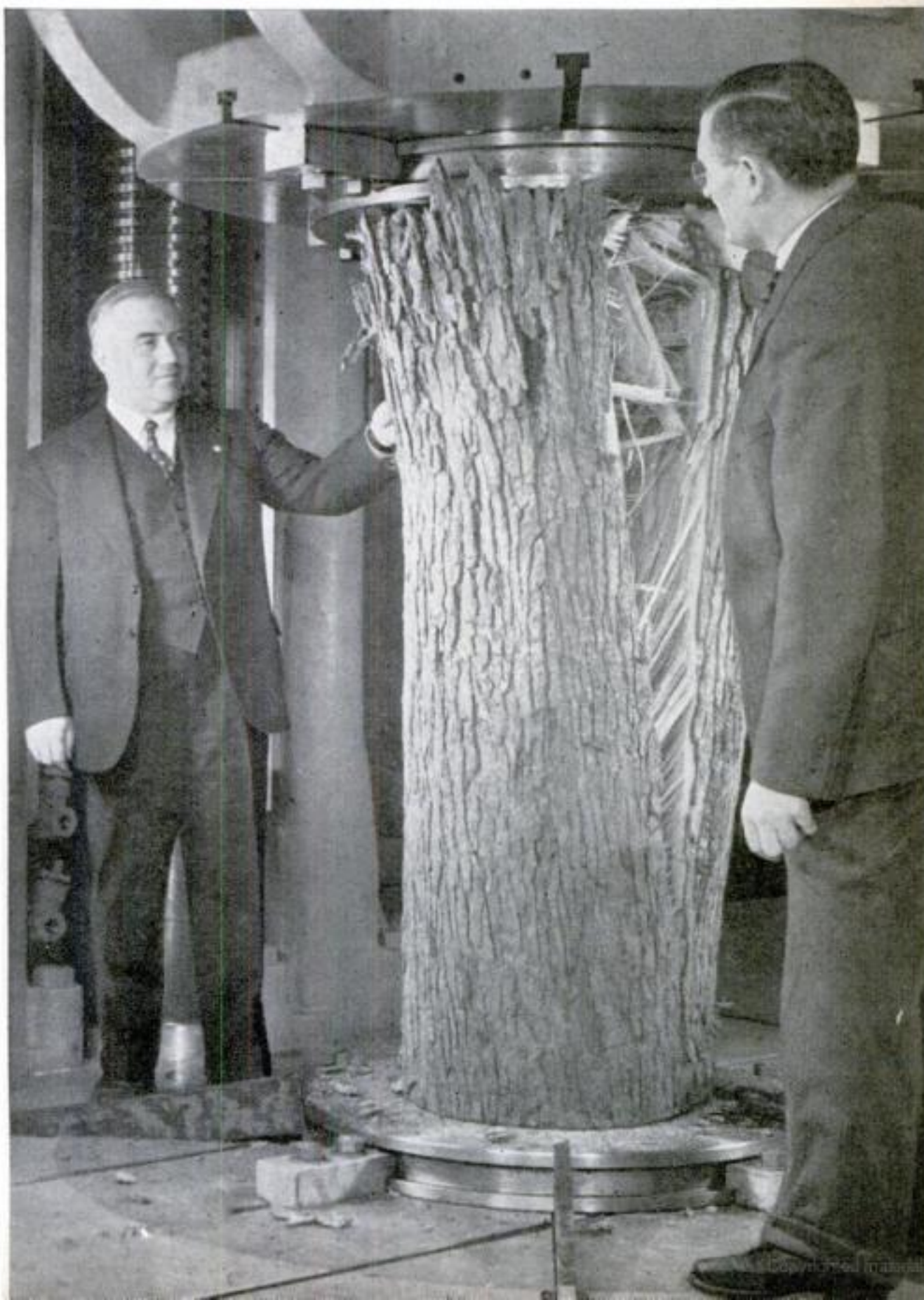
For the short, chubby, blue-eyed master of the machine, it represents five years of planning, including many a sleepless night. In perfecting its design, Templin was aided by skilled engineers of the Baldwin-Southwark Corporation, of Philadelphia, which built the mechanical monster. It arrived at New Kensington on a string of flat cars, in sections ranging up to 28 tons apiece, and a police-escorted fleet of low-hung, sixteen-wheel truck trailers bore it up the hill to the research laboratory where its might now is serving American industry.

Richard L. Templin, at right, below, shows Research Director Francis C. Frary a rivet sheared from a joint

So perfect is the control of the mighty masher that this startled chick was liberated from its shell unscathed by a gentle tap . . .



. . . while this oak-tree trunk was splintered by a 1,000,000-pound squeeze, which represents only a third of the machine's capacity





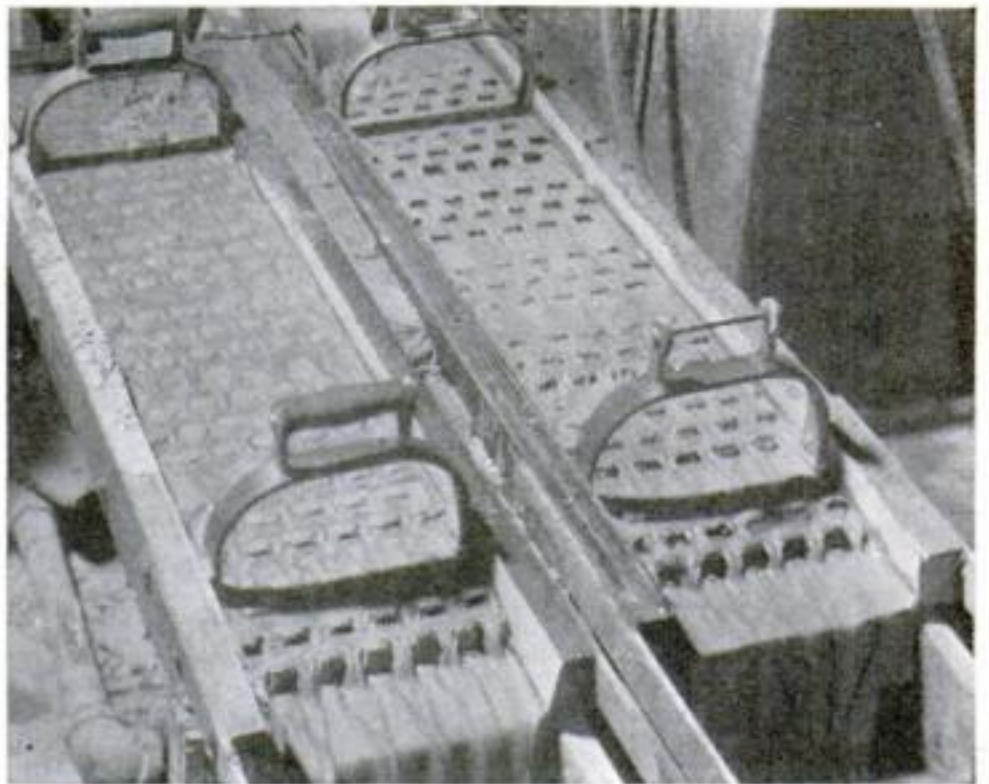
Making Insulators Is A Mud-Pie Job

You see electrical insulators everywhere. You know what they do. This story tells how they are made. The Westinghouse plant at Derry, Pa., makes feldspar into mud, and mud into insulators. But the process isn't quite as simple as that.

1 Some of the many kinds of insulators made at the Westinghouse plant in Derry, Pa. The smallest costs about a dime, the largest about \$20



2 Feldspar from Maine and North Carolina is the heart of porcelain. Because of impurities, 170 pounds are quarried for one 20-pound insulator

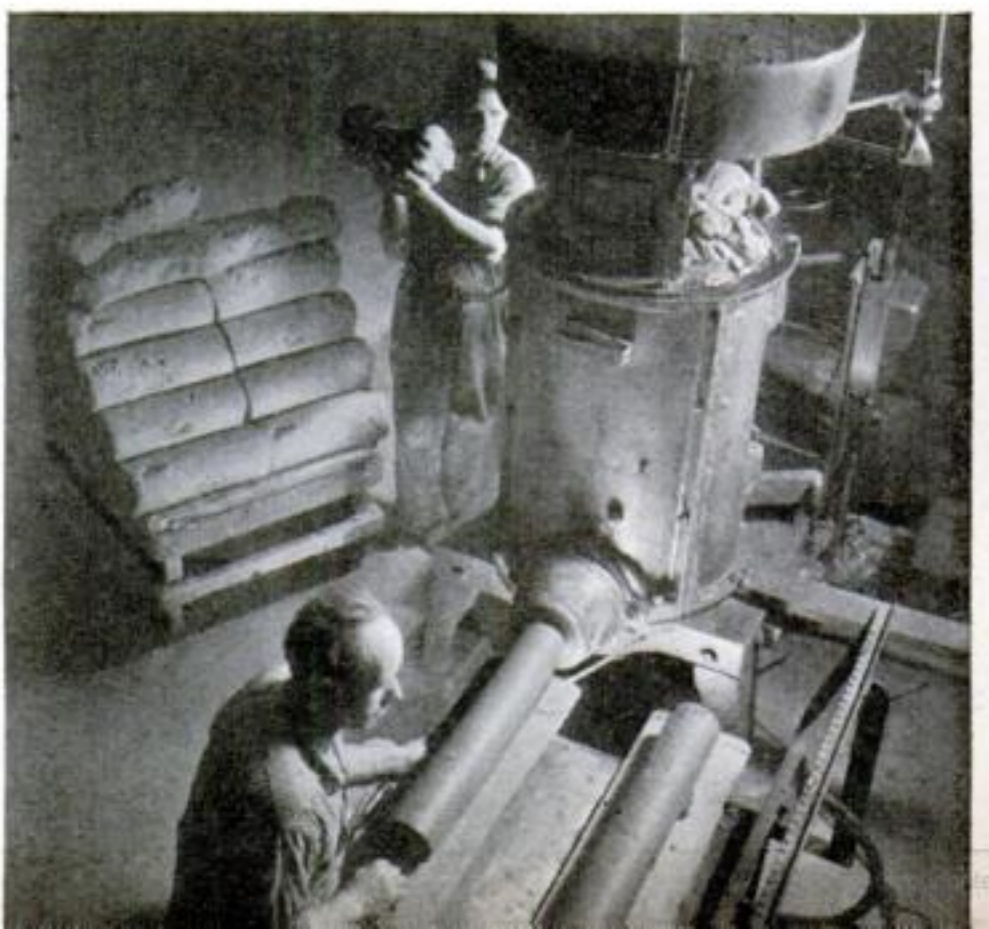


3 Clay and potter's flint are mixed with the feldspar in a watery batch called the "slip," here flowing over magnets to extract particles of iron

4 Filter presses squeeze about 75 percent of the water out of the slip and mold it into flat, round cakes like the one being removed below



5 Pug mills shape the clay into blanks for molding or, like the one below, into hollow cylinders . . .





6 . . . which are put on lathes after drying and turned to the shapes desired. This one will be a bushing. At this stage, the clay can be machined like wood



7 After more thorough drying, the insulator is dipped in a liquid glazing material. In the subsequent firing, this is turned into a hard, glassy surface



8 On bushings that need to be hermetically sealed, a band of gold-and-platinum glaze is applied and dipped into a solder pot. This tins the band . . .

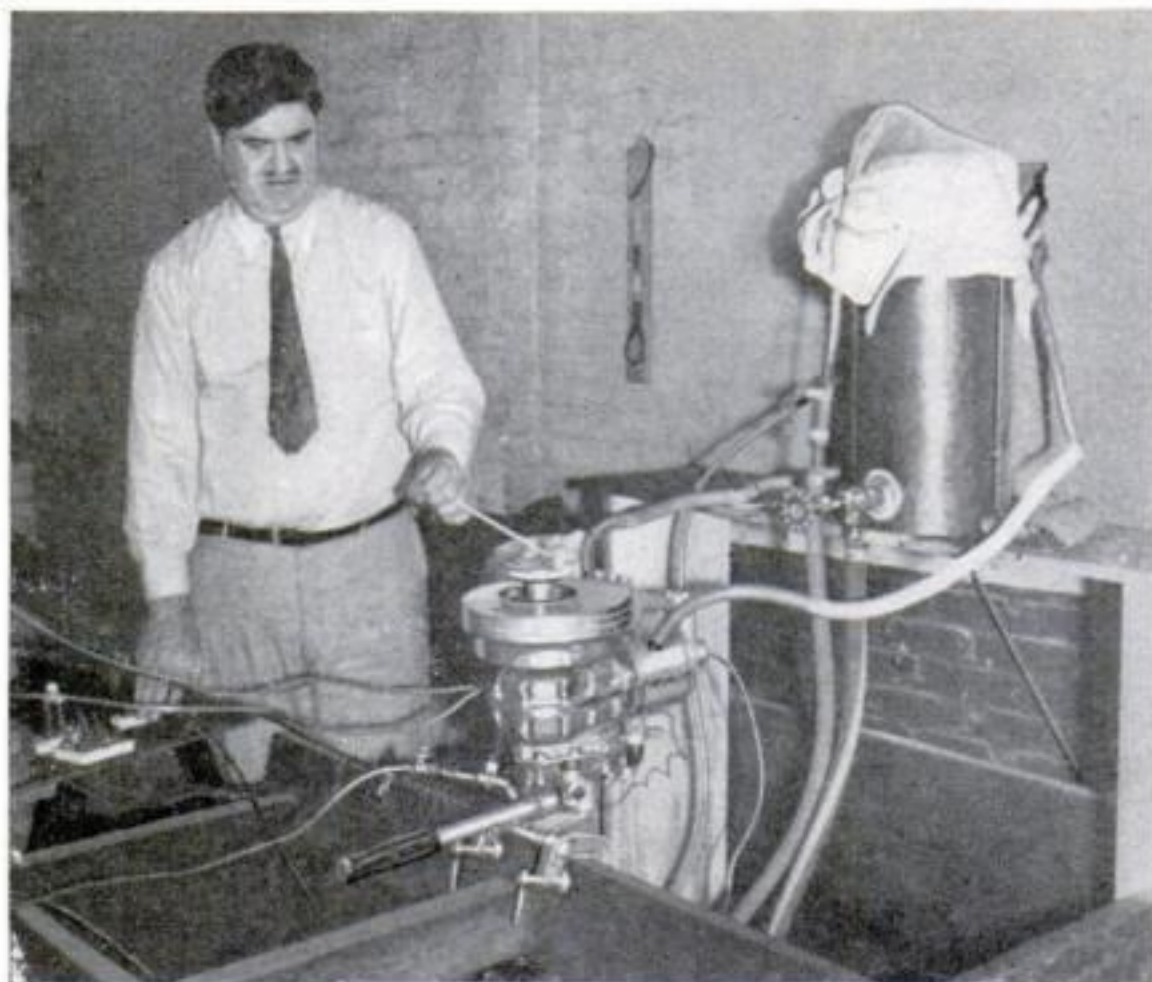


9 . . . so that a metal flange can be soldered onto it. This process was developed by Westinghouse for bushings to be used in oil-insulated apparatus

10 In the electric furnace below, the metal glaze is matured so that it merges with the original ceramic glaze and becomes a part of the porcelain

11 Testing the product: a foursome of suspension insulators taking 232,000 volts. The black lines in the flame are made by alternating-current cycles





Ashley Cooper Hewitt testing the simple single-valve-sleeve motor

This is a close-up of the sleeve and cylinder. Note the V-shaped hole that serves as a valve port



The tiny piston, shown below, has a domed top. There are only ten moving parts in the novel engine



Single-Sleeve-Valve Motor Has Only Ten Moving Parts

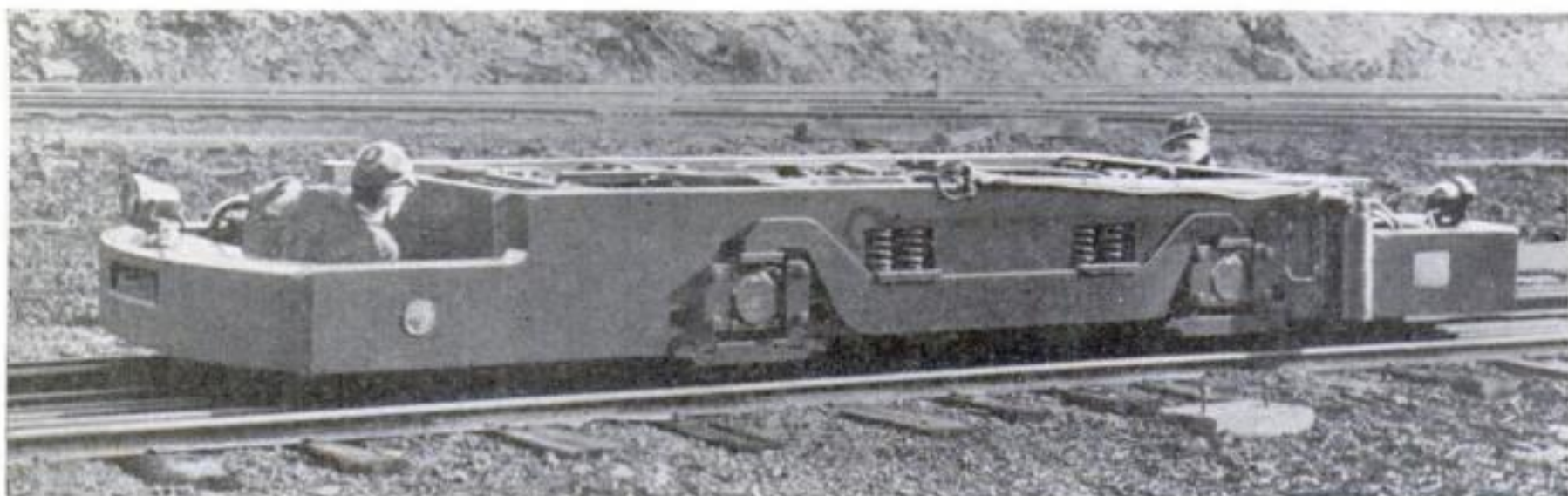
ASHLEY COOPER HEWITT, aviation and automotive engineer of Pasadena, Cal., grandson of Peter Cooper, who built the first American locomotive, has originated a four-cycle, single-sleeve-valve motor with only ten moving parts. Dynamometer tests indicate that the little engine, with bore and stroke of one and three quarters inches, develops three times the power of ordinary motors the same

size. Hewitt says that without supercharging it develops more power for its size than supercharged airplane motors. V-shaped openings in both the sleeve and cylinder take the place of valve springs. The explosions occur within the sleeve when all ports are closed. As the piston moves upward during a compression stroke the sleeve moves in the same direction, reducing friction between walls of piston and sleeve.

Electric Locomotive for Mines Needs Little Headroom

LOW-VEIN tunnel and haulage costs have been reduced immensely through the introduction of a fifteen-ton General Electric mine-haulage locomotive with an over-all

height of only 26 inches. High-speed, body-mounted, self-ventilated motors and double-reduction gear drives enable the locomotive to operate in a 40-inch vein.



Capable of operating with only forty-inch clearance, this electric mine locomotive cuts tunneling costs

Soldiers Explode Dud Shells with Charges of T.N.T.

EXPLODING the dud shells that fail to go off during artillery practice is the unenviable job of the sergeant pictured at the right. A member of the 52nd Ordnance Company, his task is to plant half a pound of T.N.T. beside the nose of the unexploded shell, attach a firing cap and fuse, then light the fuse. The exploding cap detonates the T.N.T., which in turn fires the dud shell. During artillery practice observers take compass bearings and mark on a map the locations where shells hit and failed to explode. This map is used to find the duds, although the job is made difficult by the fact that the shells may have buried themselves in the ground or skidded some distance away from the point marked on the map, making a careful search necessary.



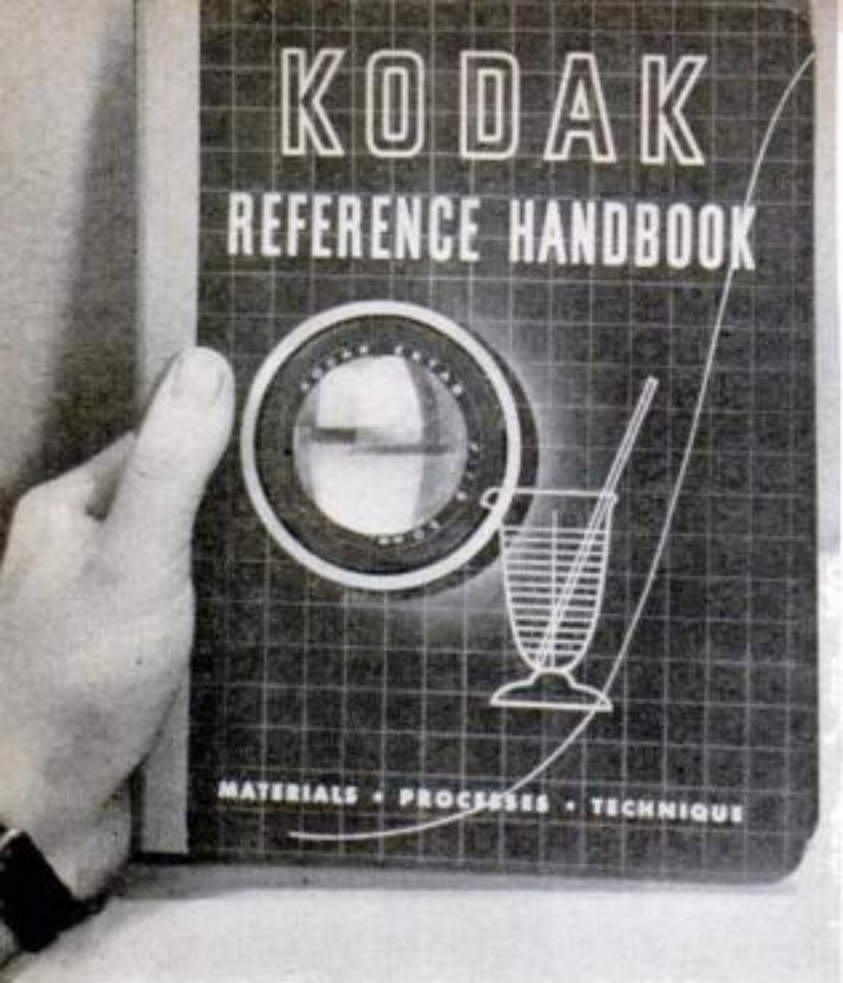
A sergeant of the 52nd Ordnance Company ready to demolish a dud



William Balluff wearing respirator during fever treatment

Lightweight "Lung" Aids Fever Therapy

TO LESSEN the strain on a patient's heart and aid him to breathe easily while undergoing artificial-fever treatment, physicians at the California Hospital in Los Angeles recently employed a lightweight portable "lung." Made of aluminum, the respirator was fitted around the patient, William Balluff, an arthritis sufferer, before he was placed in the cylindrical fever chamber where his temperature was artificially raised to 106 degrees, in an attempt to alleviate and cure his malady. Dr. Grace Jennings, in charge of the physical therapy department at the hospital, explained that two or three cases in every 100 treated by artificial fever died, due to failure of the respiratory and cardiac centers. With the use of this aluminum lung, invented by Dr. F. H. Trehaar, it is hoped to prevent such deaths.



Compactly bound in loose-leaf form, this complete manual of photography is easy to use. Index tabs mark the various sections, which have separate tables of contents

New Manual for Photographers Packs a Whole Camera Library into One Convenient Handbook

A LIBRARY of photographic information, compressed into 380 pages and bound in compact, lose-leaf form, is now available for amateurs and advanced photographers. The ten sections of the new volume, the "Kodak Reference Handbook" (Eastman Kodak Co., \$2.75) offer data and practical suggestions on everything from lenses to lantern slides. Marked with index tabs for ready reference, the different sections cover lenses, films, filters, Kodachrome, printing and enlarging papers, darkroom design and procedure, the development of films, prints and enlargements, photographic formulas, copying, and the preparing, projection, and care of lantern slides and transparencies.

The need for such a one-volume library of up-to-the-minute information has grown with the recent rapid advance in photographic technique. Text, diagrams, and data-sheets combine in the Kodak handbook to cover both the technical background and the practical application of the different branches of the art. The amateur will find it packed with information that ranges from the effect of supplementary lenses and an explanation of the circle of confusion to the best dimensions for a cellar darkroom; from the physical characteristics of photographic papers and the effect of color-separation filters to methods for cooling developing solutions during a heat wave.

In straightforward, understandable lan-

guage, the book offers common-sense rules for selecting the right lens, the right film, and the right paper for any given subject.

In addition to an alphabetical index at the front of the book, listing more than 500 items, each of the ten sections is provided with a sturdy index tab, an individual table of contents, and a strip index which increases the ease with which desired data can be found. Diagrams and photographs, several in color, illustrate the volume. Removal or insertion of pages is made easy by the use of a multiple-ring binding and the numbering of the pages in the various sections is arranged to permit the later insertion of additional data sheets. When in use, the handbook lies perfectly flat.

If your bookseller cannot supply the book you want, send your order with remittance to Book Department, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York City.

All That You Need To Know About Builders' Hardware

IN SIXTY chapters and 212 large-size pages, Adon H. Brownell's "Taking The Mystery Out of Builders' Hardware" (Hardware Age, \$3) describes available hardware accessories and their use. While written primarily for the hardware dealer, the book contains much of interest for the prospective home builder.

"Automatic Nurse" Enables Invalids To Serve Themselves

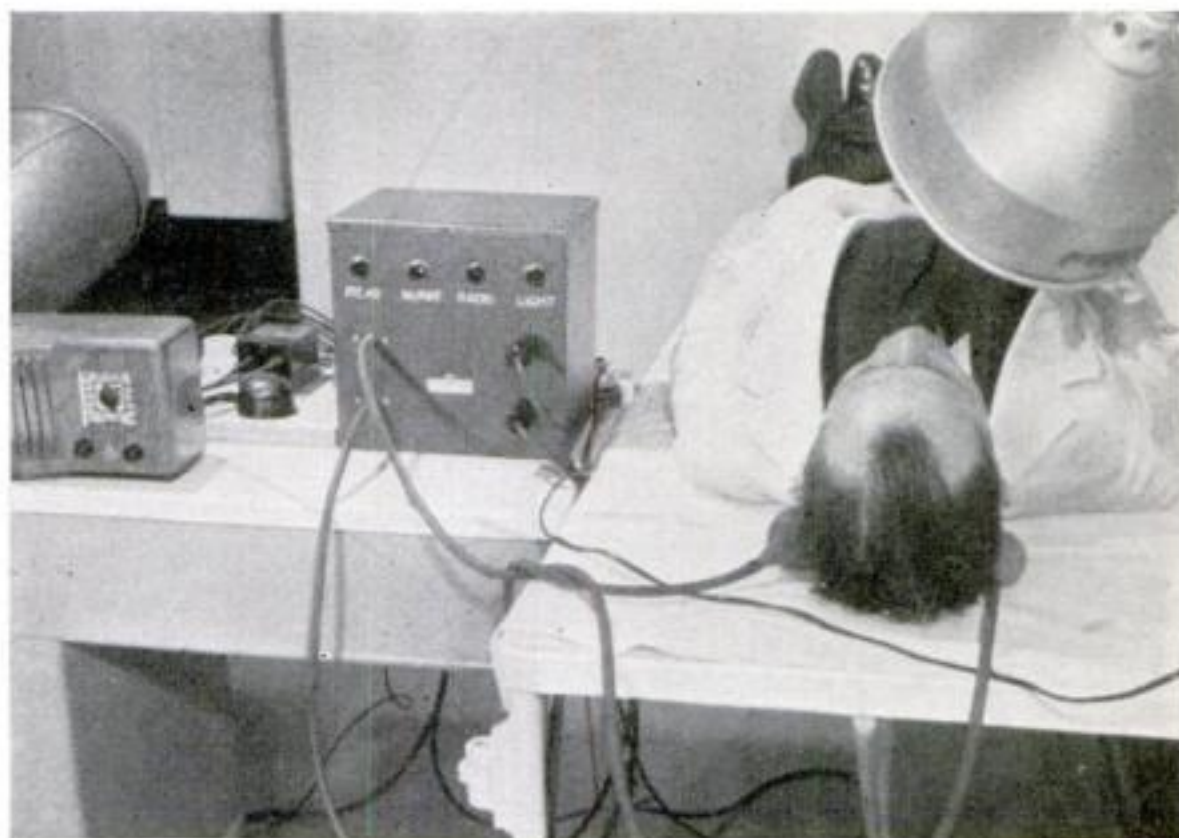
A BOON to a helpless invalid and to those who wait on him, a self-service electric outfit enables him to read, listen to the radio, and turn the lights in the room on or off. It also will ring for other aid.

The "automatic nurse" has only two controls. If a patient can use his hand, these are two push buttons. Optionally, he can operate sensitive pneumatic relays by rocking his head against a pair of soft rubber bulbs.

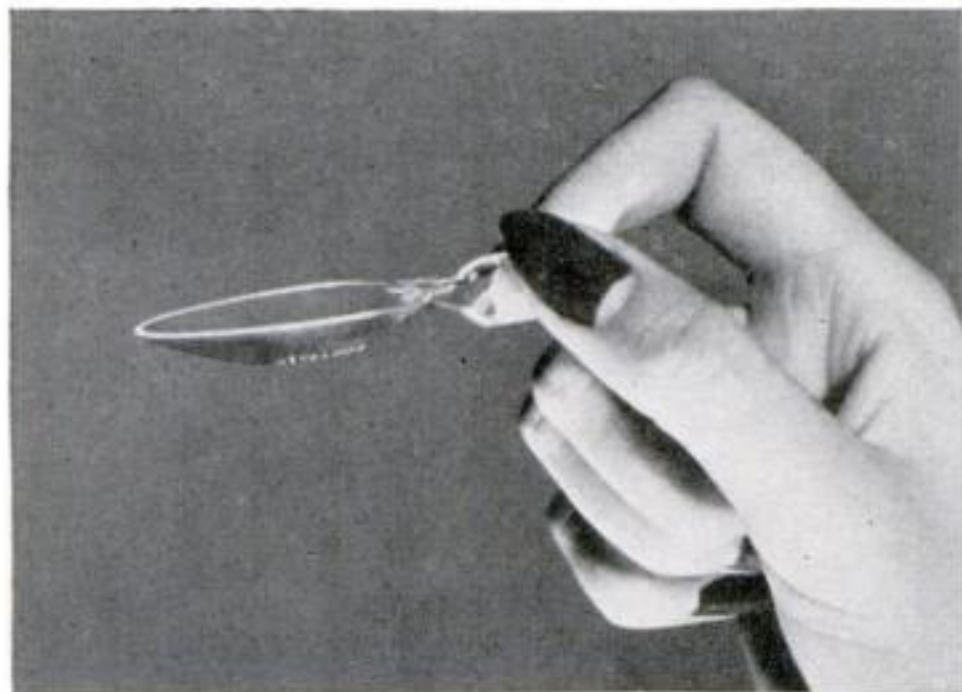
In either case, a "selector" control presets a master cabinet on a bedside table. Pressing it repeatedly lights a green lamp, in sequence, above the label "Read," "Nurse," "Radio," or "Light." When this indicator reaches the desired service, the patient gets results by operating the second, or "action," control. For reading, a special projector throws a filmed page of a book upon a wall or screen. To "turn" the page, the reader simply presses the "action" control again. In this way, he may read a whole book with a minimum of effort.



How a patient can use his hands to operate the two button controls



Here the machine is worked by rocking the head against rubber bulbs



Transparent plastic medicine spoon holds just one dram

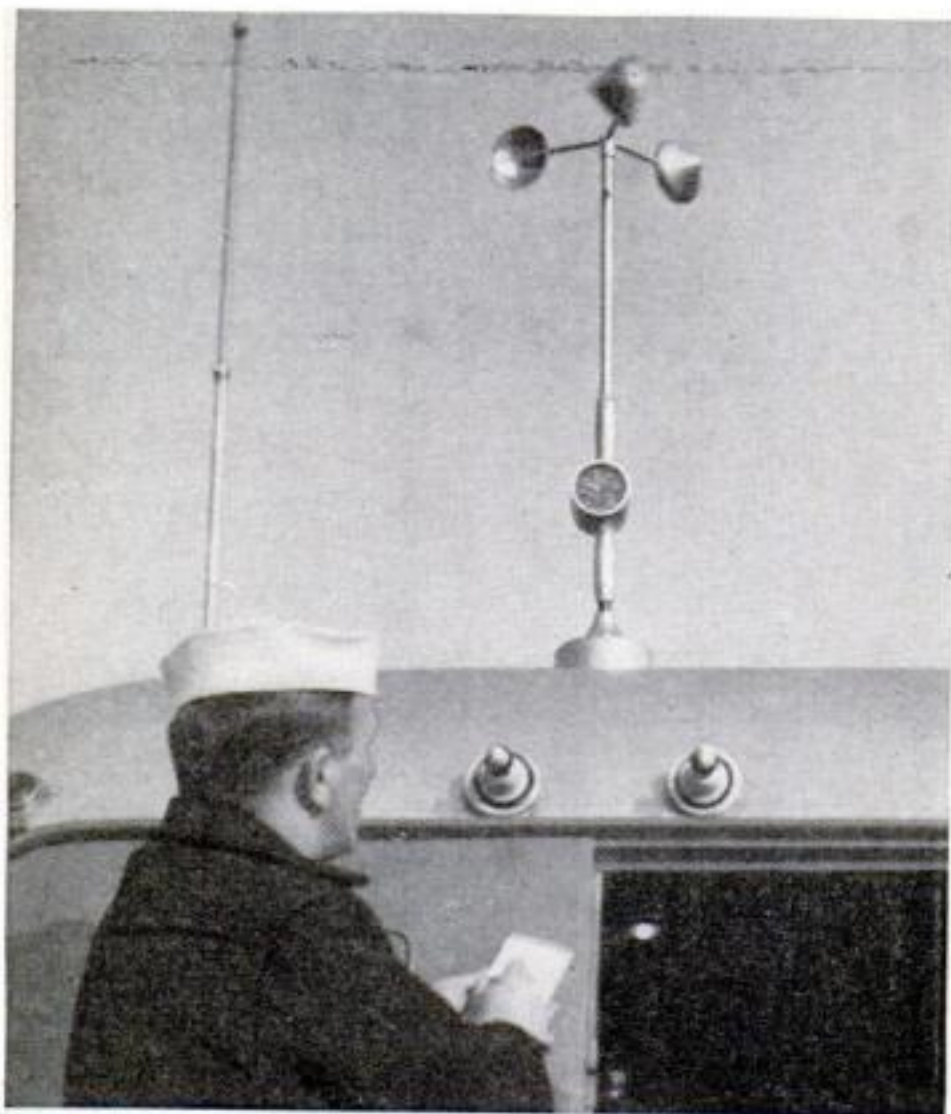
Medicines Are Measured by Scientific Teaspoon

"ONE teaspoonful three times a day," says the label on your medicine bottle. But which will you choose of the 29 different sizes of teaspoons now in use? So that you can take your potion accurately, a "medical teaspoon" of transparent plastic has been introduced by the Owens-Illinois Glass Company, of Toledo, Ohio. It holds one dram, or one eighth of a fluid ounce, the standard of leading medical authorities. The teaspoons, distributed to druggists, will be supplied with their prescriptions.

The Coast Guard Takes to Wheels



One of the U.S. Coast Guard's new emergency trucks keeps a rendezvous with a plane on flood duty



Each truck is equipped as a traveling weather station. This man is reading wind velocity from an anemometer

COMBINE in a single vehicle a radio station, an ambulance, a weather-reporting service, a fire engine, and an airport lighting unit and you have one of a fleet of emergency trucks just placed in service by the U. S. Coast Guard. For use in floods, hurricanes, and life-saving and patrol work, the trucks have been assigned to every Coast Guard district.

Each truck carries a normal crew of three. Living equipment includes a two-burner electric stove, an electric percolator, and a ten-gallon, vacuum-type water bottle for use in flood-stricken areas. A collapsible mess table, slung on the roof, may also be used as a teletype or chart table.

Elaborate radio equipment keeps the crew in two-way communication with district headquarters, for receiving orders and returning reports, including those from extra troubleshooters or "portable men" dropped off with short-range transmitters. It also dispatches local weather reports to planes, and serves as an emergency

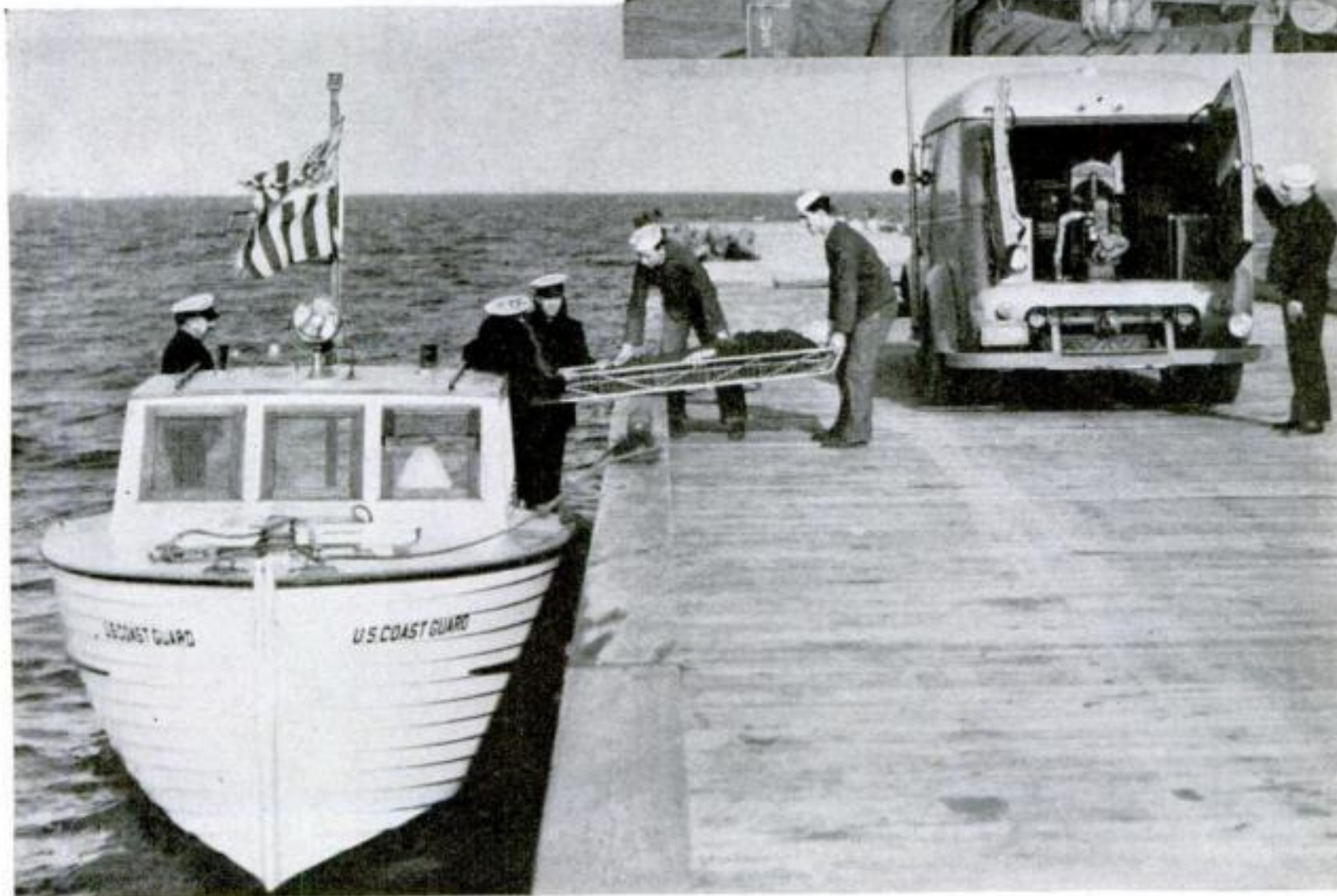
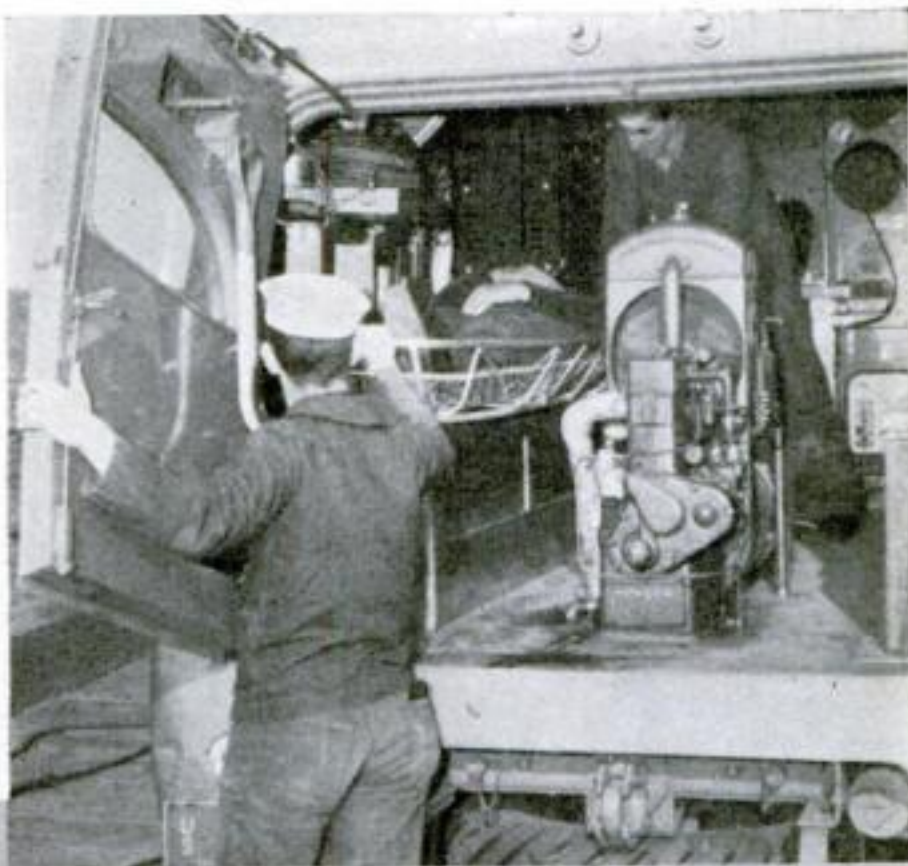


Trailing radio antennas, reeled off the spools at the right, supplement two 25-foot telescope masts

homing beacon for aircraft in bad weather. Drawn from reels, 300-foot trailing antennas can be attached to trees or housetops, supplementing 25-foot telescoping vertical antennas.

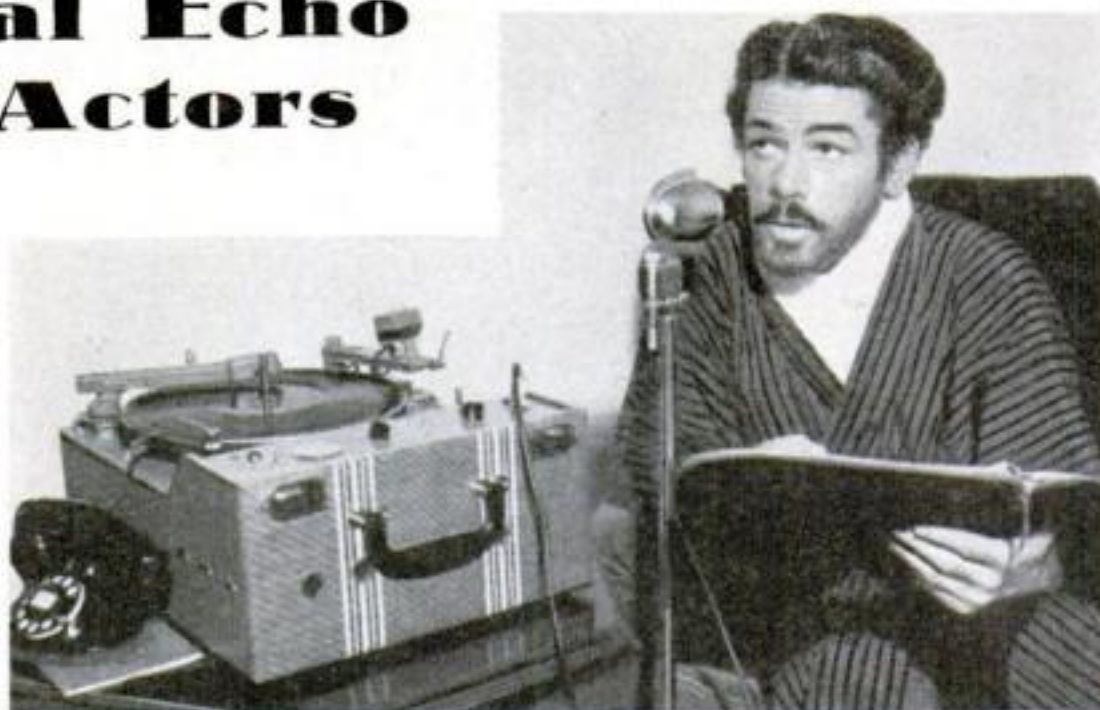
As an ambulance, the truck provides first aid, and room for two stretchers. In addition, it carries a pair of 250,000-candlepower airport-type lights to make any smooth plot an emergency landing field; a gasoline power plant to operate radio and lamps; fire extinguishers, and weather instruments.

As an ambulance, the truck carries first-aid equipment and accommodates two stretchers. Here an injured man is being transferred from a rescue boat



Mechanical Echo Coaches Actors

LISTENING to their own voices is more than a pastime for motion-picture actors and actresses. It is an important part of their training for difficult parts, in which they may be required to sound like anything from Hindu fakirs to cockney cab drivers. Recording devices are virtually standard equipment in many studios and actors' homes, and they range from ordinary dictating machines and portable outfits to complicated set-ups that would do credit to a radio broadcasting studio. By listening to play-backs of their own recordings actors can tell where they fall short of desired inflections or accents, or when they have achieved the effects they wish. In making the picture "Hudson's Bay" recently, Paul Muni recorded more than 300 speeches on 60 records while trying to perfect his dialect.



Paul Muni tests his French-Canadian accent for "Hudson's Bay"



John Sutton and Gene Tierney try out their voices for a costume picture

Question Bee

For answers see page 220. You get ten points for each one you have right. A total score of 70 is good

- 1 If you park your car on a steep hill, better play safe by (a) padlocking a wheel to the chassis (b) hanging red lanterns at front and back (c) leaving it in low gear.
- 2 Ethylene glycol makes a good (a) anti-knock fuel (b) lubricant for springs (c) radiator antifreeze (d) battery solution.
- 3 An overdrive is (a) a road crossing an underpass (b) a propeller shaft mounted in the car top (c) a system giving increased speed in high gear.
- 4 When you turn a corner, remember that the rear wheels (a) follow in the tracks of the front wheels (b) cut the corner closer than the front wheels (c) swing wider than the front wheels.
- 5 Self-starters run on (a) gasoline (b) clockwork (c) electricity.
- 6 Polarizing lenses for car headlights have been proposed, to (a) reduce glare (b) give turning signals (c) show whether the lights are on.
- 7 "Superfinish" is the name given to (a) an auto race so close that photographs must determine the winner (b) a method of making remarkably smooth bearings (c) auto enamel which dries quickly.
- 8 With the car's motor and all electrical attachments shut off, the ammeter should read (a) Charge (b) Discharge (c) zero.
- 9 If you do not grease the brake bands regularly, they will (a) overheat (b) work properly (c) suffer excessive wear.
- 10 A hydraulic transmission or "fluid drive" gives the effect of (a) an infinitely variable gearshift (b) easy riding.

AUTOS



HENRY FORD DEMONSTRATES
PLASTIC BODIES FOR CARS

NEXT PAGE

Mr. Ford Tells of Plans for Stronger Cars

By SCHUYLER VAN DUYN

TWO YEARS AGO, Henry Ford sat at a table in a laboratory and instructed a young research chemist to go ahead and find out if plastic bodies for cars were practical. Recently I sat at that same table while Mr. Ford revealed that the chemist had brought in an affirmative answer. I also learned that this research expert has just received additional instructions, this time

to try out his idea on an experimental car. This test car will utilize all the secrets wrested from test tubes by 31-year-old Robert Boyer.

It probably will be full of what the automobile engineers call "bugs." But when the bugs are removed, and when no more engineering and design problems remain, a new type of automobile will start rolling from the assembly lines of the gigantic River Rouge plant of the Ford Motor Company at Dearborn, Mich. An automobile that will have plastic body, fenders, and hood!

"It will be a car of darn sight better design in every form," Mr. Ford said. "And don't forget: The motor-car business is just one of the businesses that can find new uses for plastics made from what's grown in the land. There's no end to what can be done with them if we know how!"

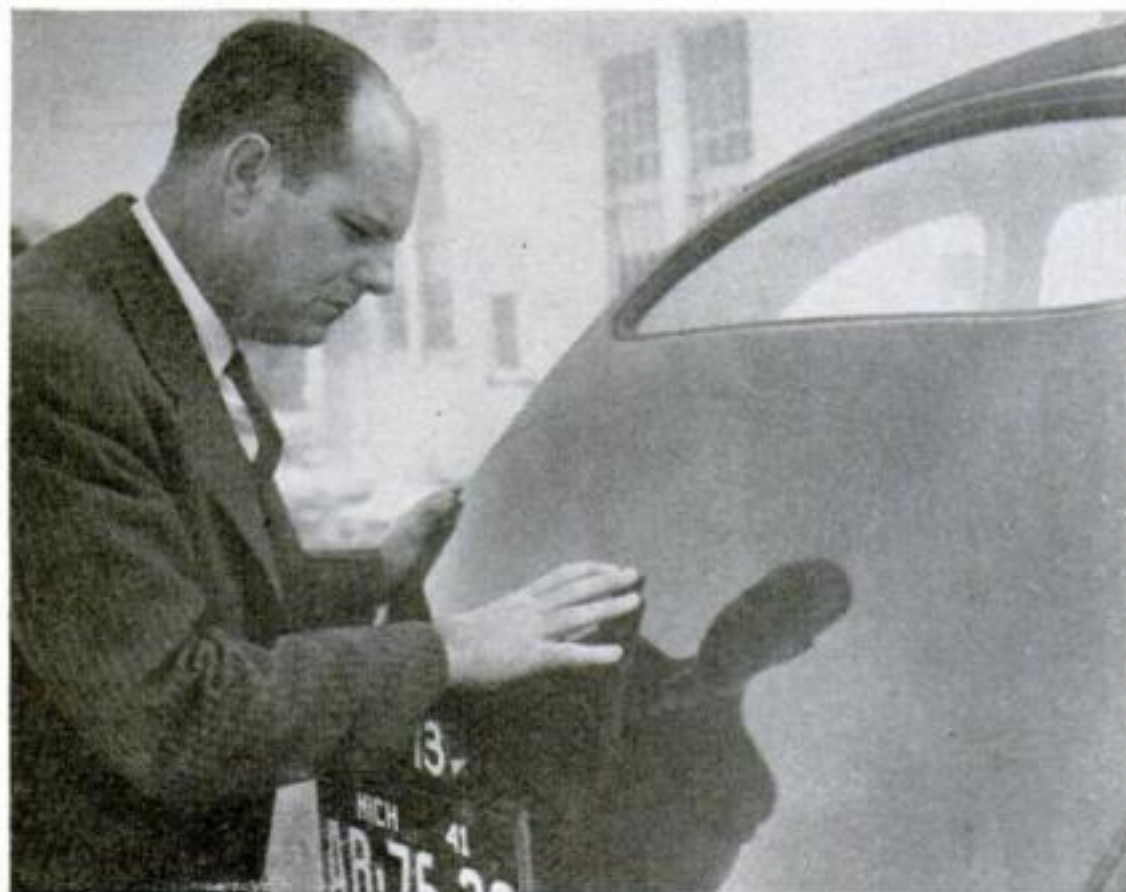
It was not dissatisfaction with present cars; but with present raw materials used for making them, that led Ford to touch off the plastic-car research. He was looking for new uses for farm products. He's found them, and the 77-year-old industrialist has also found that they'll give him and you and me what he is thoroughly convinced is a better automobile. "Safer, lighter, and less expensive," he says. He hopes other car manufacturers will soon be turning out plastic cars too, and if they do, he expects American industry to be off to new and more brilliant horizons.

Boyer, who shares his employer's enthusiasm for the possibilities of the new use of plastics, points out that there are approximately 280 pounds of farm products in every Ford built today. There will be 200 pounds more when his plastic replaces sheet metal now used. Moreover, eliminating the sheet metal and replac-



Henry Ford, at right, tells the author about his plastic-car plans. The cage-like object is a model of tubular framework proposed for cars

Robert Boyer, directing plastic research for the Ford Motor Company, inspects a synthetic-resin trunk lid being tested on Mr. Ford's car



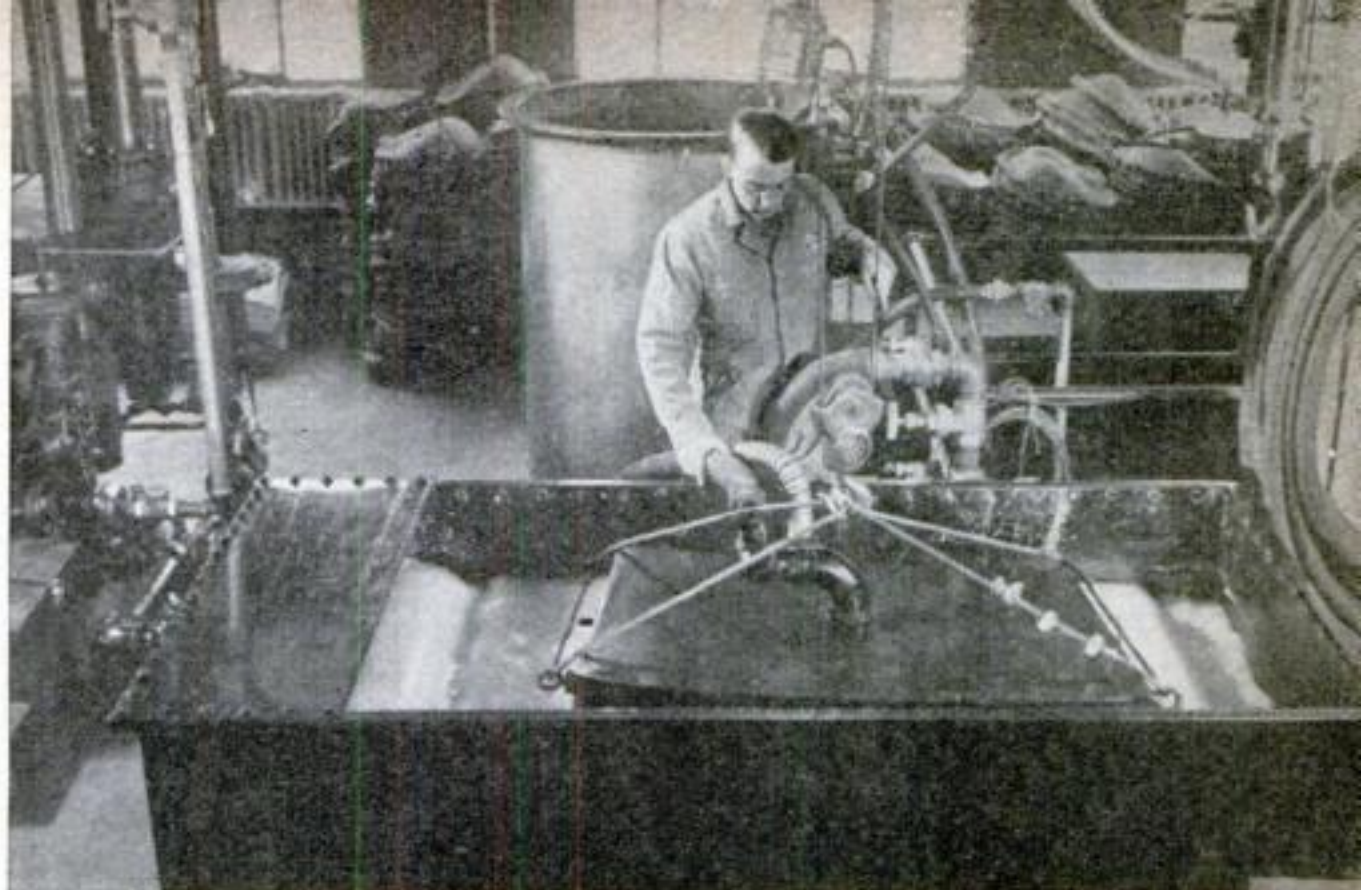
ing it with plastics will result in a car 300 pounds lighter than it is today.

In the new venture, Ford said, he is "only interested in what comes from the land." But he qualified this. "Industry, agriculture, and transportation are the three things that make the world go round," is the way he put it, and the "industry" and "transportation" items no one can deny are already his province. He now wants more than anything else to put the "agriculture" item in the position of being the pacemaker for the two others. In short, he wants America to grow her own raw materials to feed the factories that turn out the machinery of transportation—cars, trains, trucks, airplanes, vehicles of every type possible.

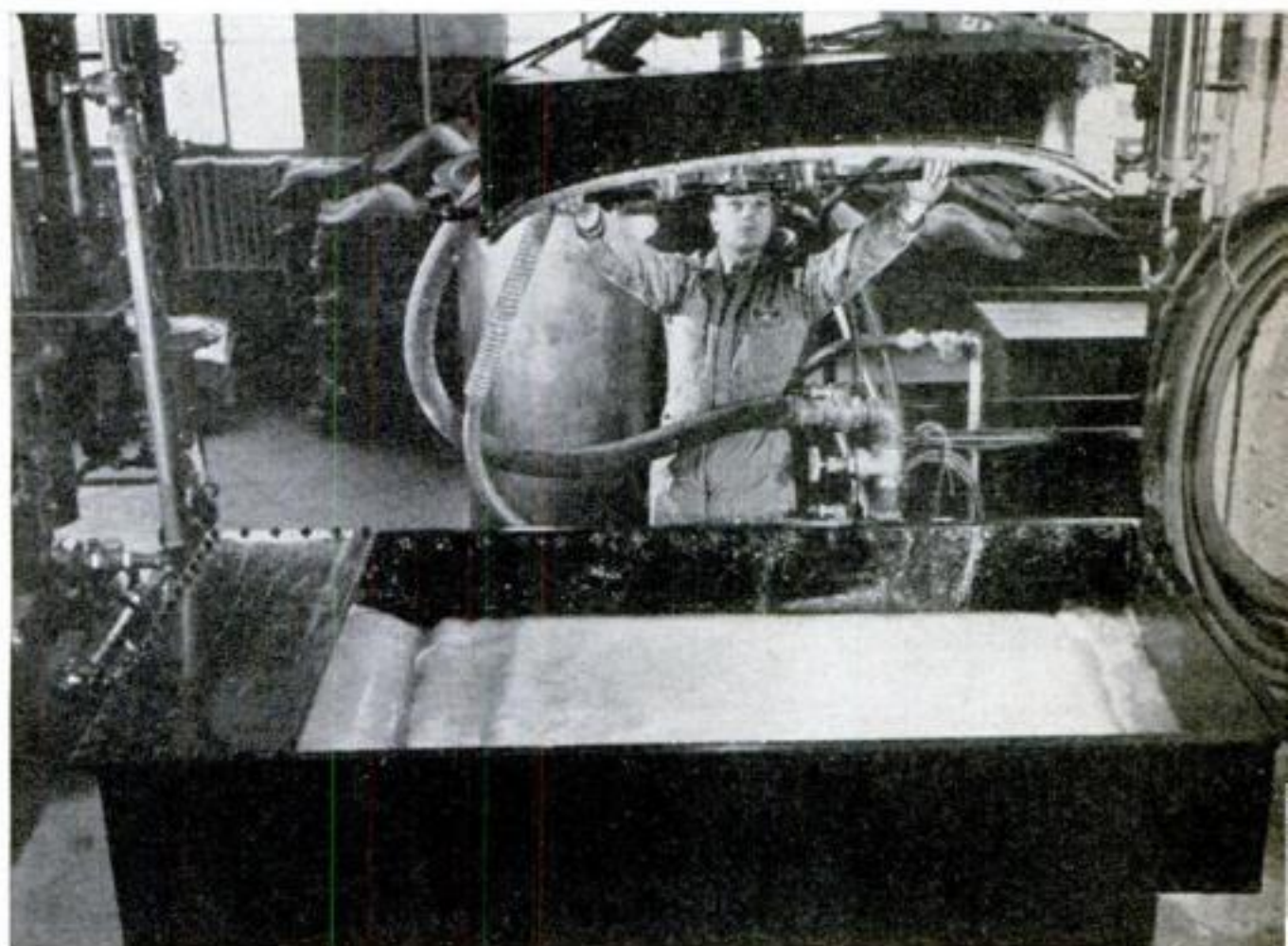
Few understand better than Boyer the intense enthusiasm Ford has for getting industrial raw materials from agriculture. A dozen years ago, Boyer, son of the then manager of Ford's Wayside Inn near Boston, immortalized by Longfellow's "Tales of a Wayside Inn," was a serious-minded, athletically inclined high-school student. Ford and the boy's father urged him to take a year at the Ford Trade School at Dearborn. He had been there two years when Ford happened one day upon an article in a technical journal describing experiments with chemicals derived from the soy bean. This little-analyzed vegetable would thrive, he learned, in our climate.

Convinced of Boyer's capabilities, Ford set him up in what passed as a laboratory, but could be described more aptly as a well-kept barn, and told him to go to it: find out everything there is in a soy bean and what it could be used for.

A 1,000-gallon still was Boyer's first piece of equip-



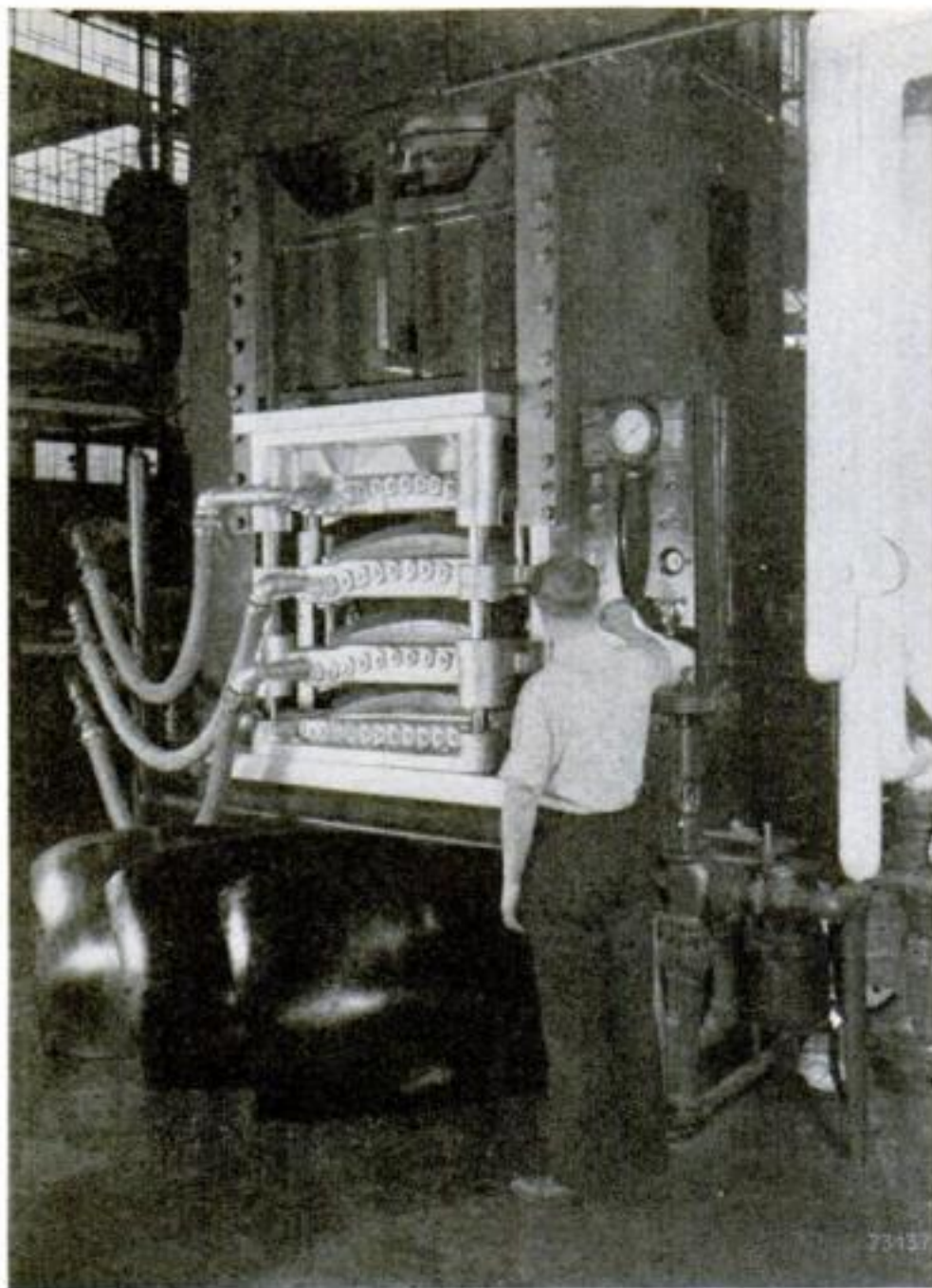
Making an experimental body panel of plastic: A rough form with a screened surface is lowered into a tank containing plant fibers



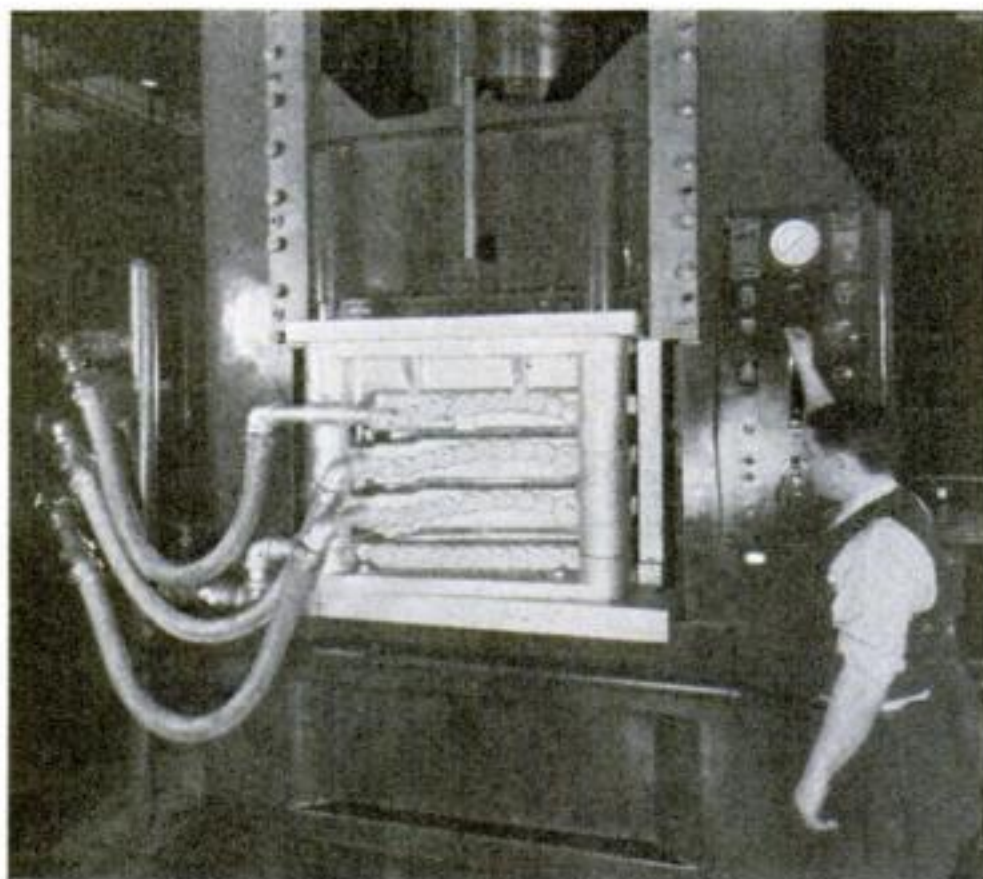
Suction pulls the fibers from the water mixture against the screen, matting them in the desired shape. The form is then raised, and . . .

. . . the molded fibers are released. The panel has now taken rough shape and is ready to be saturated with liquid phenol resin (over)





Three of the resin-soaked fiber panels go into a hydraulic press. In actual production, a press would take six panels to equal the output of the metal-stamping presses now in use



Steam-heated dies clamp down on the panels to press them into final shape. Studs for attaching the panel to the frame, and to receive window and door fittings, are molded in the panel

ment. It still is the dominating object in the same crowded laboratory where Boyer's 30 assistants—average age 24 years—work over benches laden with chemical apparatus. In the still, the soy bean was made to "tell all," and among its many secrets was the fact that it possessed basic materials for a cheap thermosetting plastic. Today, 21,375 tons of soy beans—grown in this country—go into plastics in each 1,000,000 Ford cars, the number turned out in an average year, and Ford operates one of the largest plastic-molding plants in the nation. And because of its many uses in other industries, the soy bean today ranks as our No. 4 cash grain crop.

But because soy-bean plastics are relatively brittle, they will not provide the material for plastic bodies. Still, Boyer's experience with them put him in a position to head up the plastic-body research for his employer. Slightly more than a year after he got his orders, he had installed on Mr. Ford's personal car a rear trunk lid which he had made of plastics.

To make it, he matted a mass of short and long fibers obtained from hemp, flax, and ramie. They are among the strongest fibers known. The matting was done in water. The water was extracted and a common phenol-resin compound similar to the raw materials of Bakelite was forced into them. Set in specially made dies, the matted fibers and resin were then subjected to pressure and heat in a hydraulic press. The product, shaped to the desired size and curves, was tough, with a finish just as polished as the die in which it was pressed, and with chemical stability to withstand heat. In fact, while it can be charred at high temperature, no amount of heat would ever soften it again. In addition, it was virtually impervious to moisture.

The black trunk lid looks no different from the rest of the black sedan. In a recent demonstration of its toughness, Ford swung on the panel with an ax. The blow did not even leave a dent. But when he swung the ax on a conventional sheet-metal

trunk lid, the results were just what you've guessed—a deep dent and badly scarred paint.

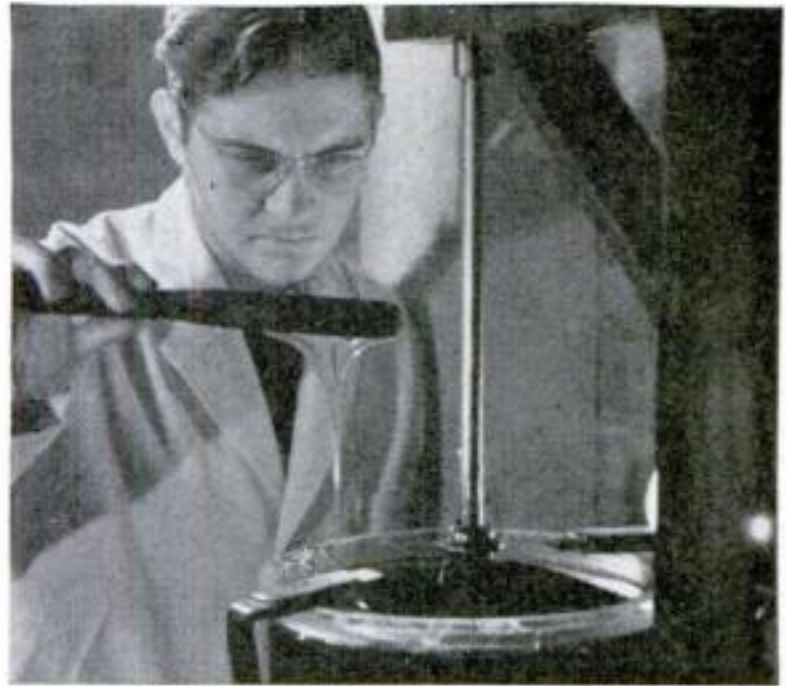
The fiber materials in the tested lid, and in the plastic that will go into Fords of the future, are obtained from domestic crops. Currently, the resinous materials to be used as a binder are made synthetically. But if a way can be worked out to get them from the farm, it will be adopted.

Ford says that the test model Boyer is readying now will not necessarily set the style and lines of future Fords, and important style changes are being considered. Exactly what they will be is not yet being revealed. But there are several structural changes that he is glad to talk about. There seems to be no doubt, for example, that the heavy bridge-girder-type chassis of present cars will give way to two strong horizontal steel tubes connected by tubular cross members. From each rear corner of the chassis, tubular arches of lighter weight will run diagonally toward the front of the car, crossing each other at the center of the roof, and ending near the engine mounts. Additional lengths of tubing will connect and brace the arches and form the frames for doors and windows. All joints will be welded.

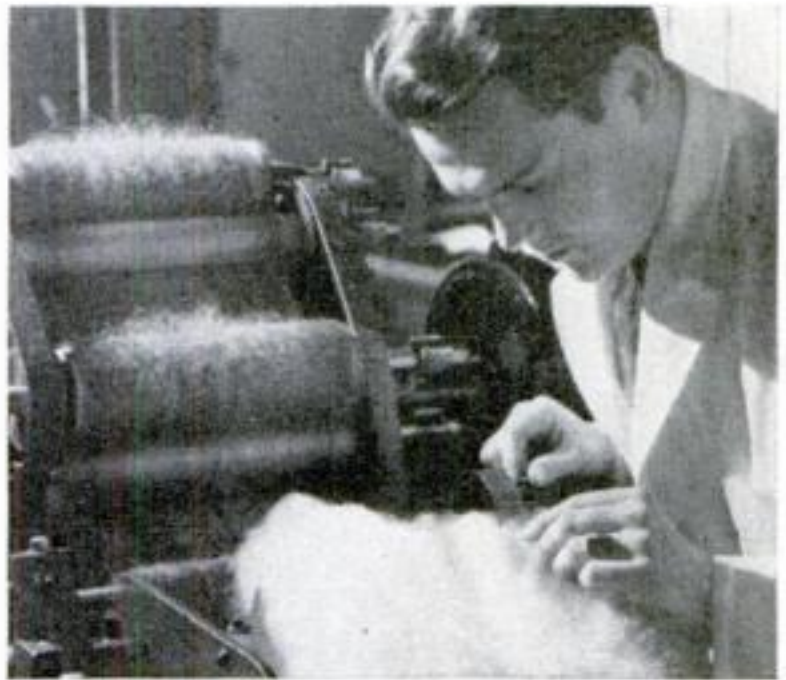
To this tubular skeleton, the plastic body panels, fenders, and other surface parts will be fastened, probably by means of stud bolts set in as the panels are molded. Similar studs would be used for mounting windows, door hinges and latches, and other parts. Engine, springs, and other mechanical units would be mounted by conventional methods on the new-type tubular chassis.

The net result expected is a car frame 15 percent lighter and a body as much as 50 percent lighter. Ford sees in this important safety advantages in case of accident or collision. To begin with, plastic bodies will have ten times as much impact resistance as steel, a point he was proving when he swung the ax on the trunk lids. (*Continued on page 220*)

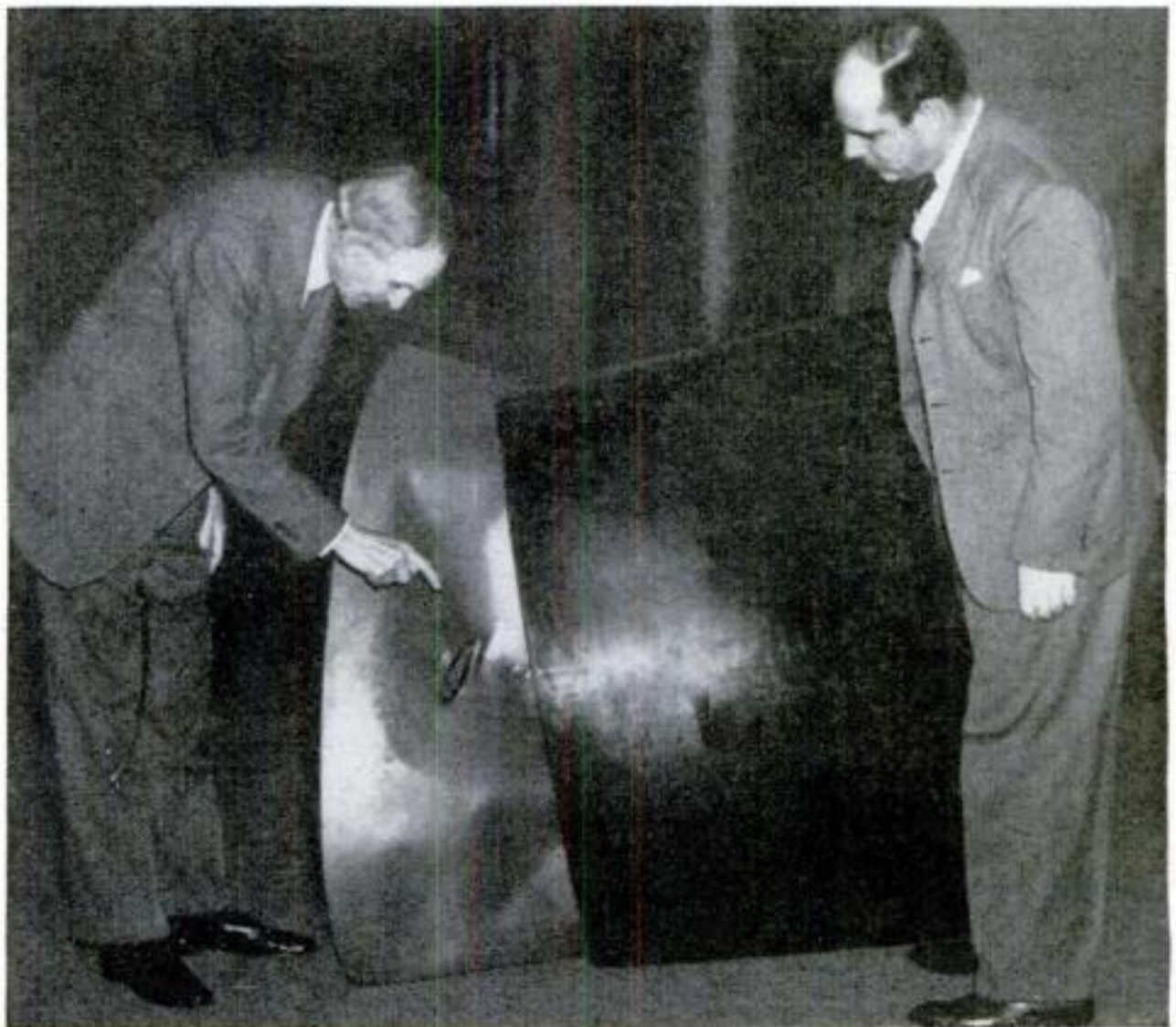
Proof of the pudding: Mr. Ford points to a hole he put in a sheet-metal trunk lid with an ax. Beside it is a plastic panel which got the same treatment but never lost its shape under the pounding. The new body material cannot be softened by any amount of heat, and has been found to be virtually impervious to moisture



Research with soy-bean compounds paved the way for the present experiments in plastic bodies



Here a chemist studies soy-bean protein fibers, which were analyzed for possible use in cars





Ralph DePalma, right, examines air filters from a new car. They should be cleaned regularly, he insists

GETTING THE MOST OUT OF Your New Car

**Ralph DePalma, Famous Racing Driver,
Gives Some Good Advice on What To
Do—and What Is Best To Leave Alone**

THE FIRST THING Ralph DePalma does when he buys a new car is to read his instruction book. It's as easy as rolling off a log, yet few new-car buyers do it until they begin to wonder what's wrong under the hood. Then, it's usually too late.

The famous race driver who until last summer had driven more miles in competition on the Indianapolis Speedway than anyone else, can't understand it. Car makers, he points out, annually spend thousands of dollars preparing the

Jobs like this, DePalma points out, are not for the car owner. An expert here is checking manifold vacuum with a gauge. Even if you had such a gauge, you wouldn't know exactly the right adjustment



books, but too few of us get ten cents' worth of good out of them.

After you've read the book carefully, then get in your car and learn to drive it, DePalma advises. For the new position of the steering wheel, brake and clutch pedals, accelerator, and seat will require the learning of many new driving habits.

Be particularly careful to stick within the speed limits recommended by the manufacturer for the early mileage, he further emphasizes. Watch your oil level, check your tire pressure frequently, and examine your engine often for leaks in the gasoline lines and cooling system.

Car makers guarantee new cars for a given time or mileage. So DePalma sees no reason why he should attempt to adjust his carburetor, tinker with wheel bearings and brakes, or change the car's factory-set timing. Particularly when trained mechanics are ready and waiting to do it for him, when needed, free of charge until the guarantee expires.

Even after the new-car-service guarantee expires, he prefers to "let the expert do it." By then, however, the car owner can "take over" certain maintenance duties. He can clean his carburetor air filter and the too-much-neglected air filter in the cap on his oil-filler pipe. He can add miles to his car's life by regularly changing the oil and grease. He can avoid slamming on his brakes and jamming down his accelerator except in emergencies. He can maintain proper tire pressure, keep upholstery clean, keep the finish polished.

And if he does all these things, you can take it from Ralph DePalma that he will be rewarded with fewer repair bills. More than that, he'll get a pleasant surprise when he goes back to his dealer to buy a new model and learns the turn-in value of his well-kept old car.

MARCH, 1941



Crankcase oil tells much about the motor. Here Ralph DePalma looks for telltale water, sludge, and dirt in oil drained from a motor



Be extremely cautious of your driving in a new car. It takes time to get the feel of the new positions of the wheel and other controls

Take good care of the finish of your car. This not only gives you the satisfaction of good appearance, but also adds trade-in value



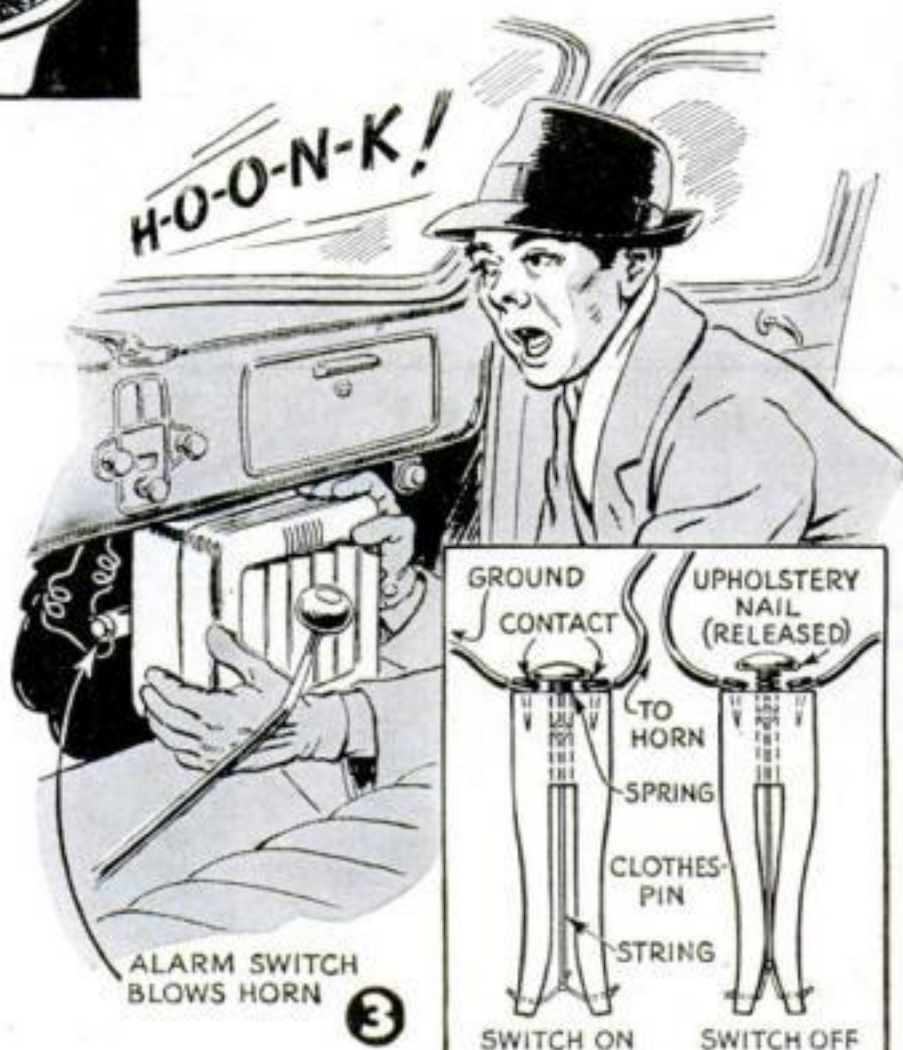
EIGHT HANDY TIPS



1 CLEANING DIRTY GEARS and engine parts to which grease, sludge, and gummy deposits are clinging is simplified with a blow torch which has been filled with gasoline and pumped up to full pressure. Place the parts to be cleaned in a pan or a clean pail, and open the torch jet so that it shoots a stream over the dirty surfaces.—C.L.R.



2 A HANDY FLASH-LIGHT STAND for motorists can be made from a piece of strong steel wire and an old hose clamp. Bend loops in each end of the wire to make a snug fit on the hose-clamp bolt. Bend the wire into a triangle and then bend it again to form the base. Attach the clamp to the flash-light barrel so the base of the stand folds against the base of the lamp. Replace the clamp nut with a thumbscrew.—M.R.

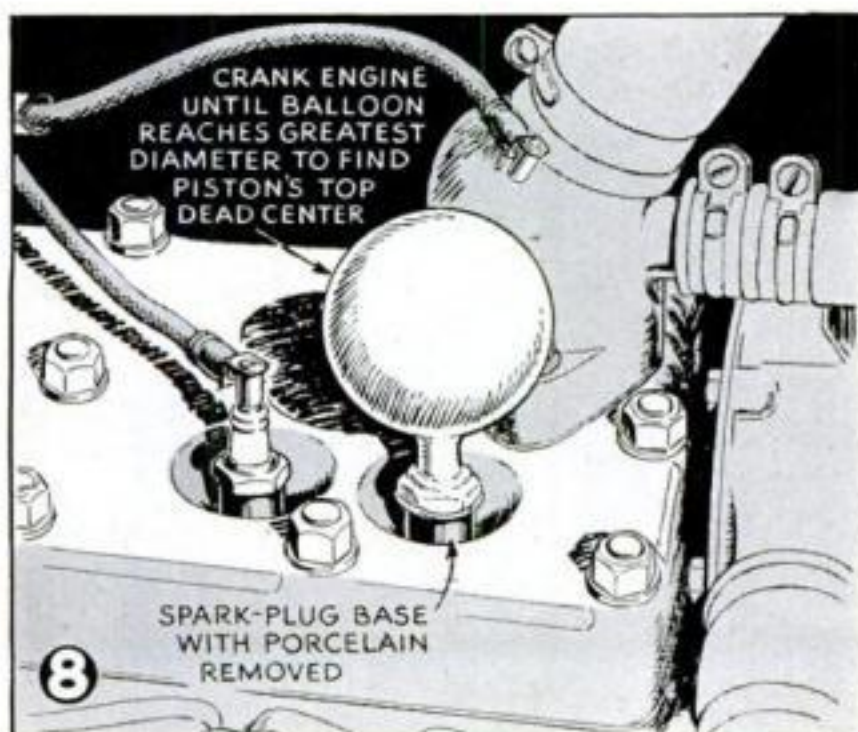
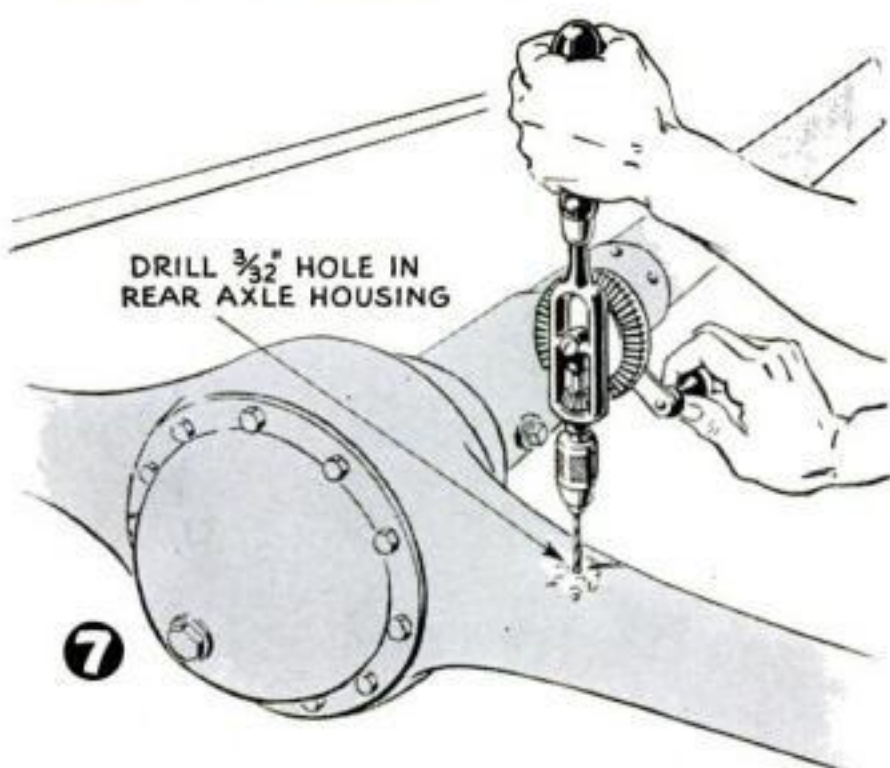
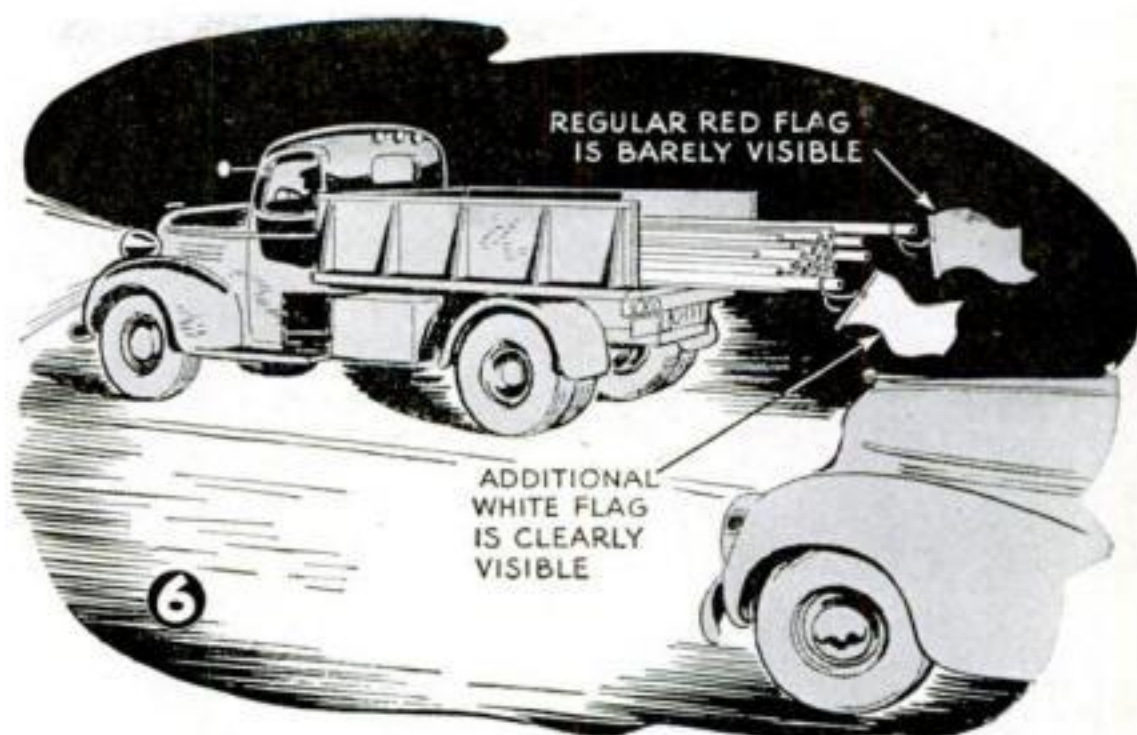


3 A BURGLAR-ALARM SWITCH attached to your horn and placed behind the heater blows the horn if the heater is removed. Cut and drill a clothespin as shown. The center string is tied to a hook bent in the point of the upholstery nail whose head forms the switch contact when the removal of the heater allows the feet of the clothespin to spread.—P.M.

4 CORROSION PROTECTION for battery terminals is afforded by covering them with candle grease. Simply hold a lighted candle on its side over each terminal and let the melted wax flow thoroughly over the exposed metallic surfaces of each terminal until completely covered.—H.T.S.



FOR THE MOTORIST



5 SLEEVE PROTECTORS to keep dust, grease, and oil from spotting your cuffs while doing small jobs on your car are provided by the wax-paper wrappers that store bread comes in. I find it handy to carry a few of them in the car on long trips. An elastic band snapped over the wrists holds them in place.—A.H.W.

6 WHITE FLAGS SHOW UP BETTER than red ones at night. Therefore, whenever I am hauling an overhanging load on my truck at night, I put both a red and a white flag on the overhanging materials, the red to comply with the law, and the white to insure good visibility for other drivers.—A.H.

7 A VENTED REAR-AXLE HOUSING on some of the older cars will prevent grease from the differential case from being forced through the oil seals of the wheel bearings to damage brake linings. Drill the hole at the top of the housing as shown. Air expanded by changes in temperature can thus escape without building up pressure in the housing to force the grease out—R.S.

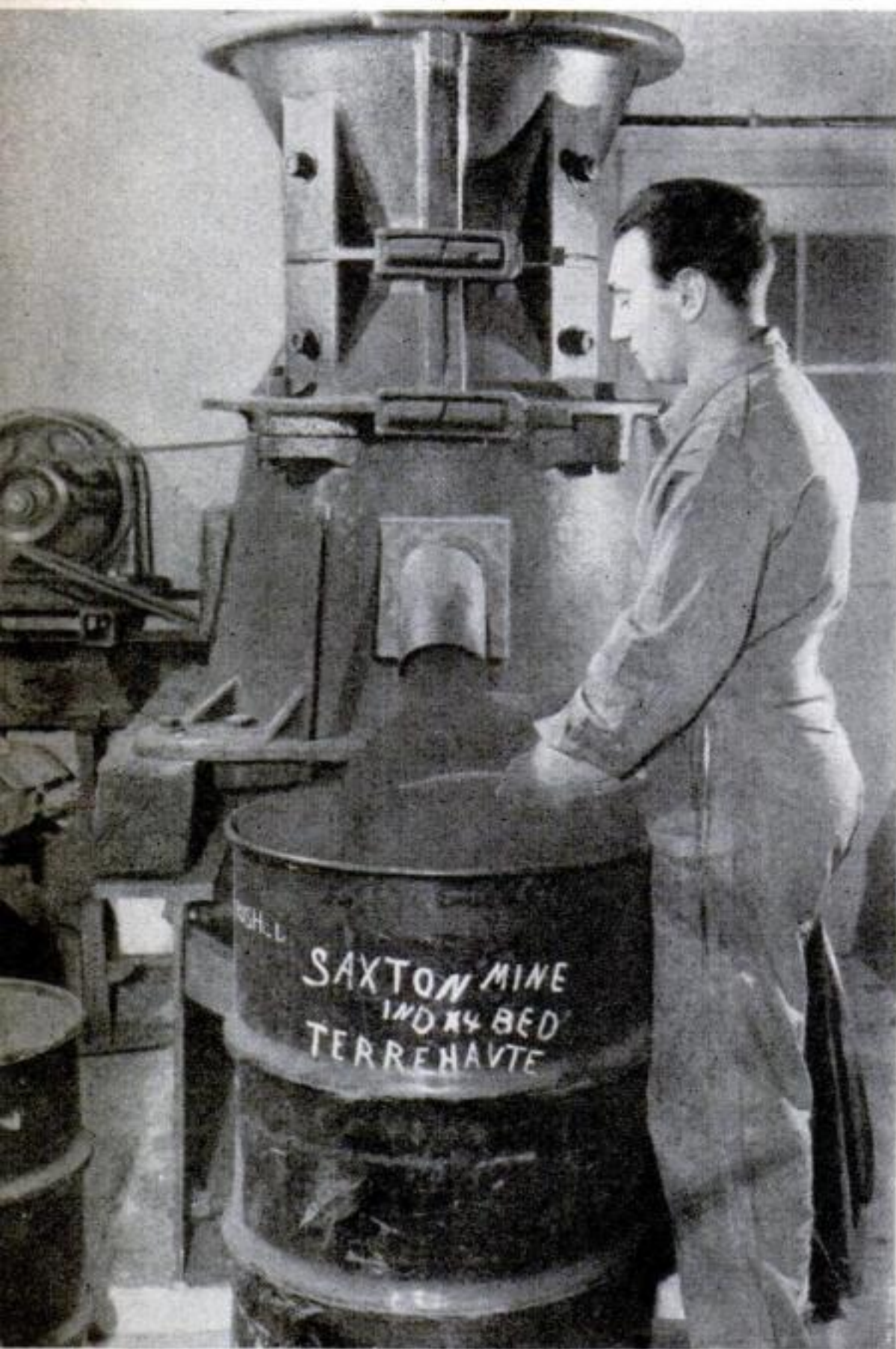
8 FINDING TOP DEAD CENTER of a piston with a toy balloon attached to the base of an old spark plug from which the porcelain has been removed speeds the job considerably. It also provides a good check on whether there is any serious loss of engine compression. Screw the device in a spark-plug hole and crank the engine slowly by hand. When the balloon stops expanding, top dead center has been reached.—R.D.

American Research Produces Gasoline from Coal

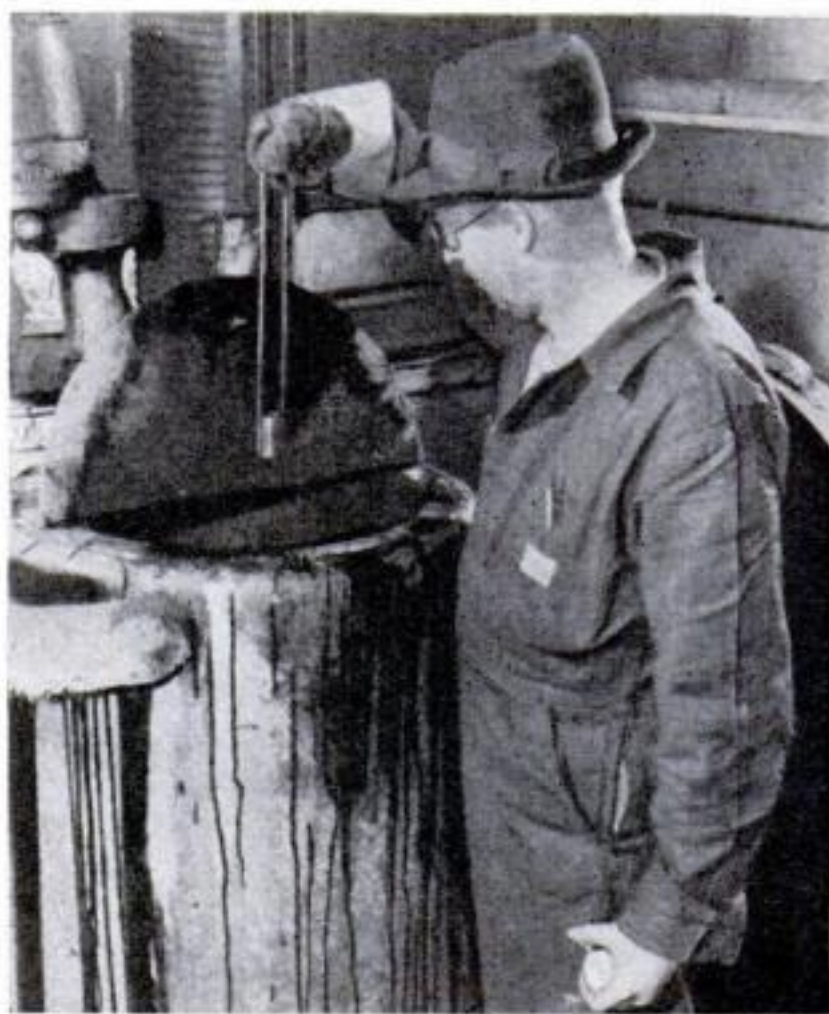
By ALDEN P. ARMAGNAC

MADE out of coal, an all-American synthetic gasoline has begun streaming from towering, asbestos-jacketed stills at the U. S. Bureau of Mines experiment station in Pittsburgh, Pa. Initial samples of the product, sent in black drums to the Gulf Research Laboratories, already are being tested in a laboratory-type engine. Road trials of these or improved samples are expected to follow soon. Chemical wizardry has created a new fuel for the country's motor cars and airplanes of the future.

On a small scale, the Pittsburgh experimental laboratory demonstrates how Germany currently manufactures large quantities of synthetic gasoline, to make up for

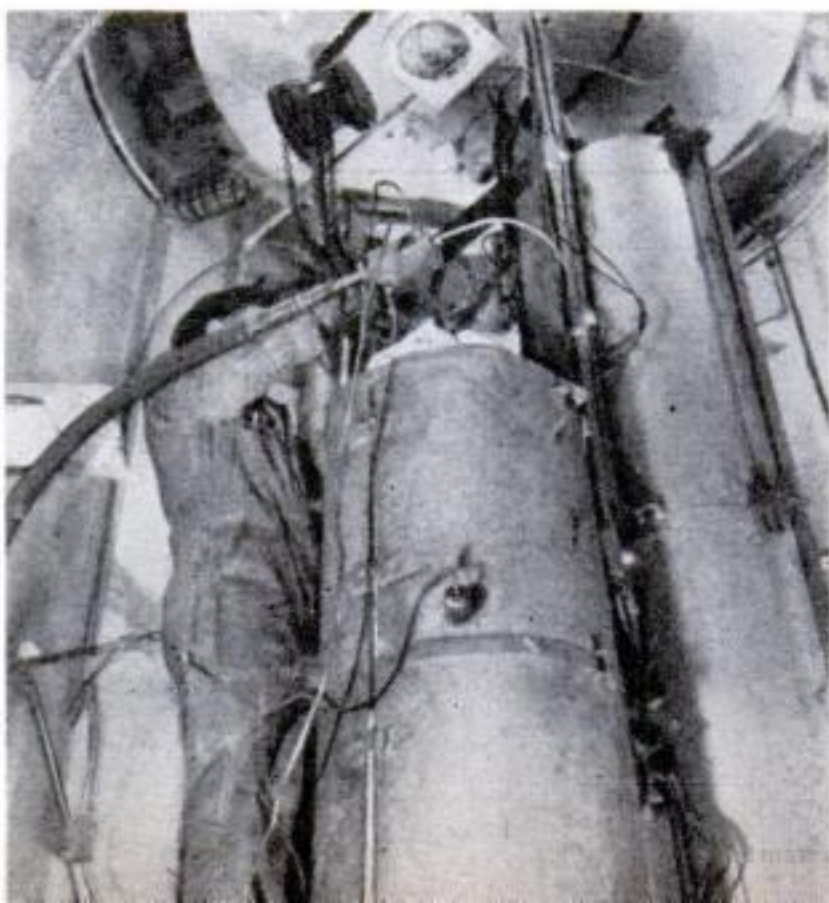


Lumps of coal slide down a chute into this grinder, and powdered coal comes out at the bottom. The receiving drum is marked to show the source of the fuel, for comparison



Powdered coal is mixed with heavy oil and a catalyst into a paste, here being tested

In a high-pressure tube, coal paste and hydrogen swap molecules to form light oil



her lack of natural petroleum. American progress in the same direction has been pressed less rapidly, since the nation's vast known reserve of untapped oil preclude any immediate shortage. But how long the underground pools will last remains a controversial question. Some experts place the figure as low as 15 years—in contrast with coal deposits good for 1,000 to 4,000 years.

Looking ahead, therefore, research men of the Coal Hydrogenation Laboratory are making advance preparations for the time when motorists and pilots may switch to a synthetic motor fuel. For years they have studied how to turn all kinds of coal into light oil, an intermediate product in making artificial gasoline. That part of the problem

has been thoroughly solved. Now, using a pair of newly procured stills—chemists would call them fractionating columns—they are trying their hand at the final step of converting the light oil into gasoline.

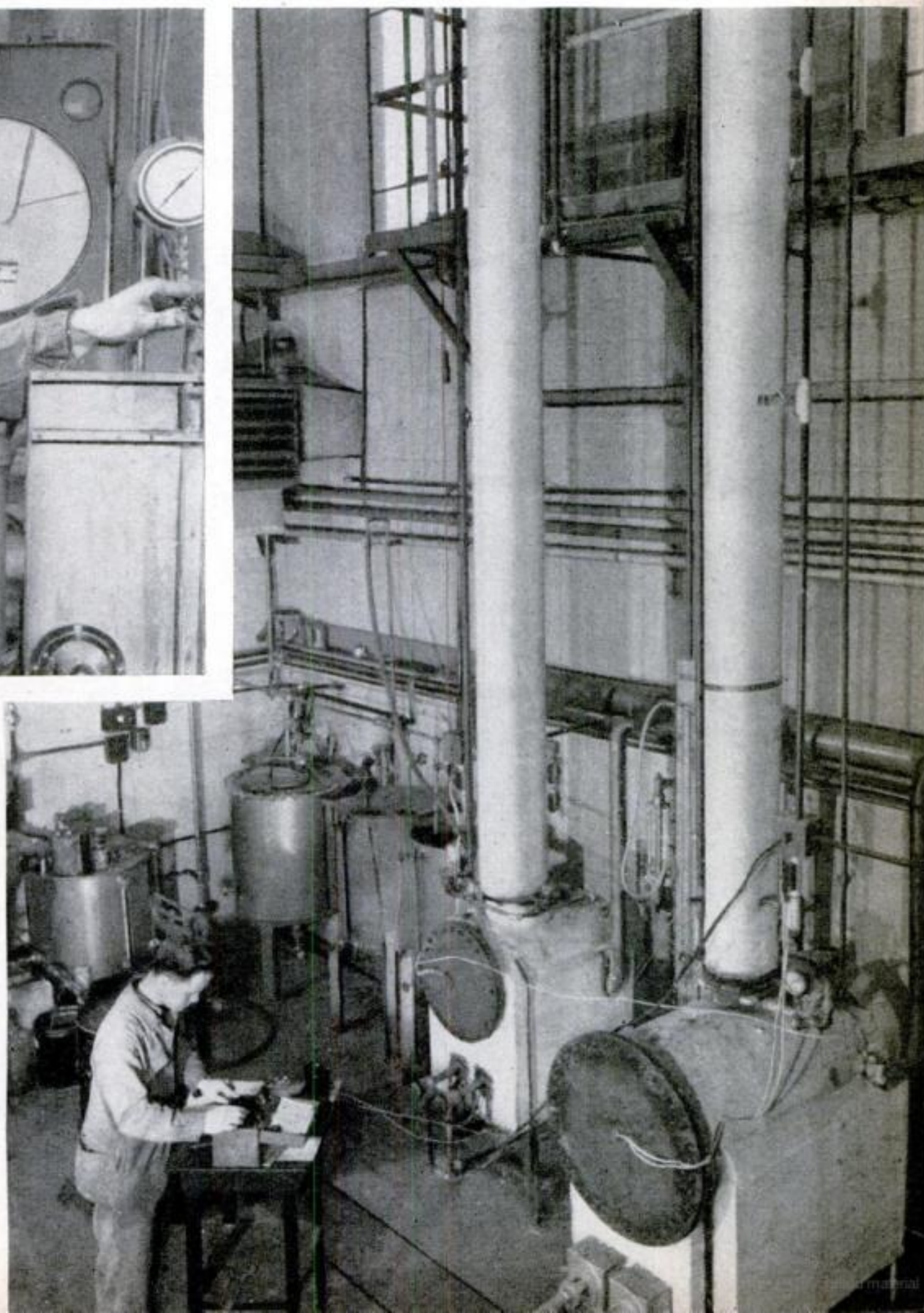
Here are the high spots of the whole process: Powerful grinders reduce big chunks of mined coal to powder, which is mixed to a liquid paste with heavy oil and a catalyst. To test the consistency of the coal-oil paste, an attendant dips up a sample with a viscosimeter—a thimblelike cup with a hole in the bottom—and times with a stop watch how long it takes it to run out.

Hydrogen gas is needed, too. In an electric furnace outwardly resembling a heating boiler, steam and natural gas com-



Hydrogen used in the process is made by combining steam and natural gas. Since carbon monoxide is a by-product, masks like this are kept ready for emergencies

Another shot of hydrogen converts the light oil into raw gasoline, which goes into these towering stills to be distilled into synthetic motor fuel. The observer is measuring the temperature in the heated columns at right



bine to form hydrogen. Carbon monoxide, the poisonous by-product, reacts with more steam in an adjoining catalyst chamber, yielding more hydrogen. Removing excess steam and harmless carbon dioxide, the second by-product, leaves pure hydrogen.

Now the scene shifts to the "pill box," a small circular chamber where the coal-oil paste and hydrogen are forced under tremendous pressure into a tall, heated reaction tube. Bored in a gun factory, it must withstand thousands of pounds to the square inch. In case it doesn't, the main force of the blast will be dissipated by a wide, doorless entry leading outdoors. Walls armored with an inch of solid steel, and observation windows four inches thick safeguard workers within the building. There hasn't been an explosion, so far—but they're taking no chances.

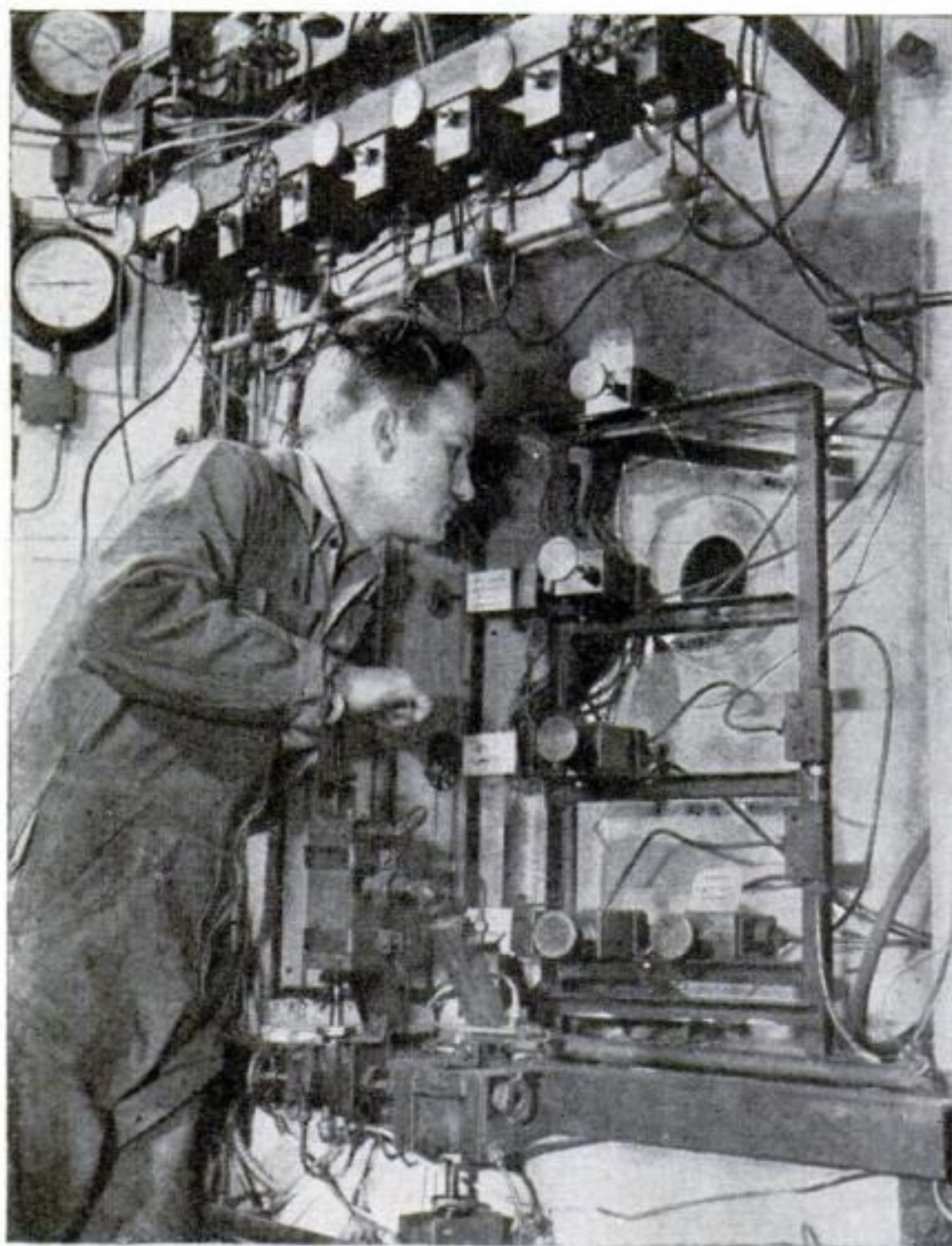
Within this reaction tube, the chemical miracle called hydrogenation takes place.

The coal disappears completely in the game of swapping molecules. When the reaction is over, the principal things left are light and heavy oils. Heavy oil goes back to make more coal-oil paste; the Pittsburgh laboratory wastes no materials it can re-use. Light oil, the desired product, remains and becomes the raw material for the second and final stage of the process. Another dose of hydrogen in a high-pressure reaction tube converts it into raw or impure gasoline—a mixture of compounds ranging above and below the volatility of those in good gasoline. Finally the two-story-high fractionating columns, operated at carefully controlled temperatures, distill pure gasoline from the mixture.

Today the experimental station produces a comparative trickle of synthetic gasoline—from 10 to 15 gallons daily—at a cost of several dollars a gallon. A second step in the development of artificial gasoline

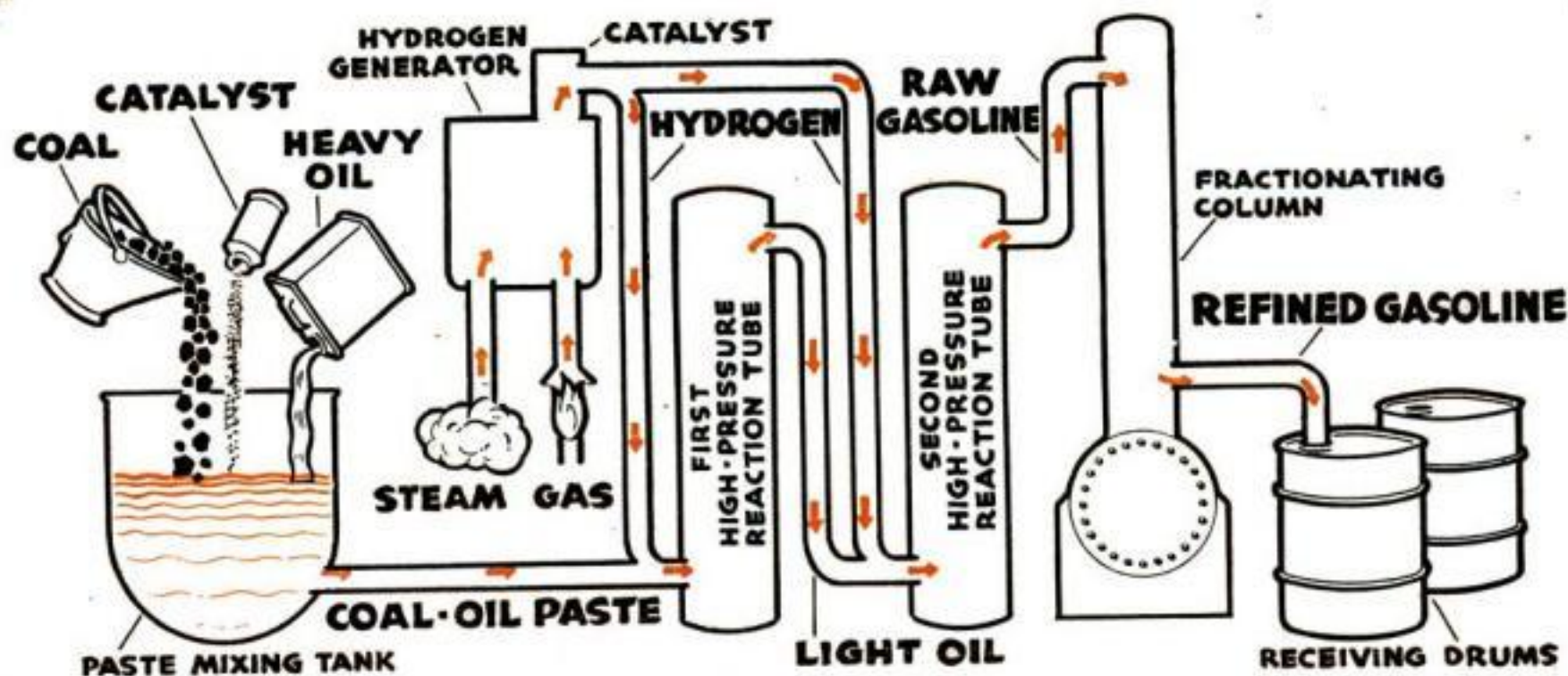
for introduction to the public will logically call for a larger, semi-commercial plant where the problems of mass production at low cost can be studied and mastered. The final step would be full-scale factories, using banks of high-pressure reaction tubes 50 to 60 feet high. And this will come about, some predict, as soon as increasing oil scarcity raises the price of ordinary gasoline enough to meet the decreasing cost of the synthetic product.

Pictures on these pages show the experimental plant



Surrounded by a maze of control valves and indicators, an operator watches the high-pressure reaction tube through a glass window whose thickness is shown in the picture at the right. Because of the possibility of an explosion, all workers within range are protected by walls armored with one-inch steel



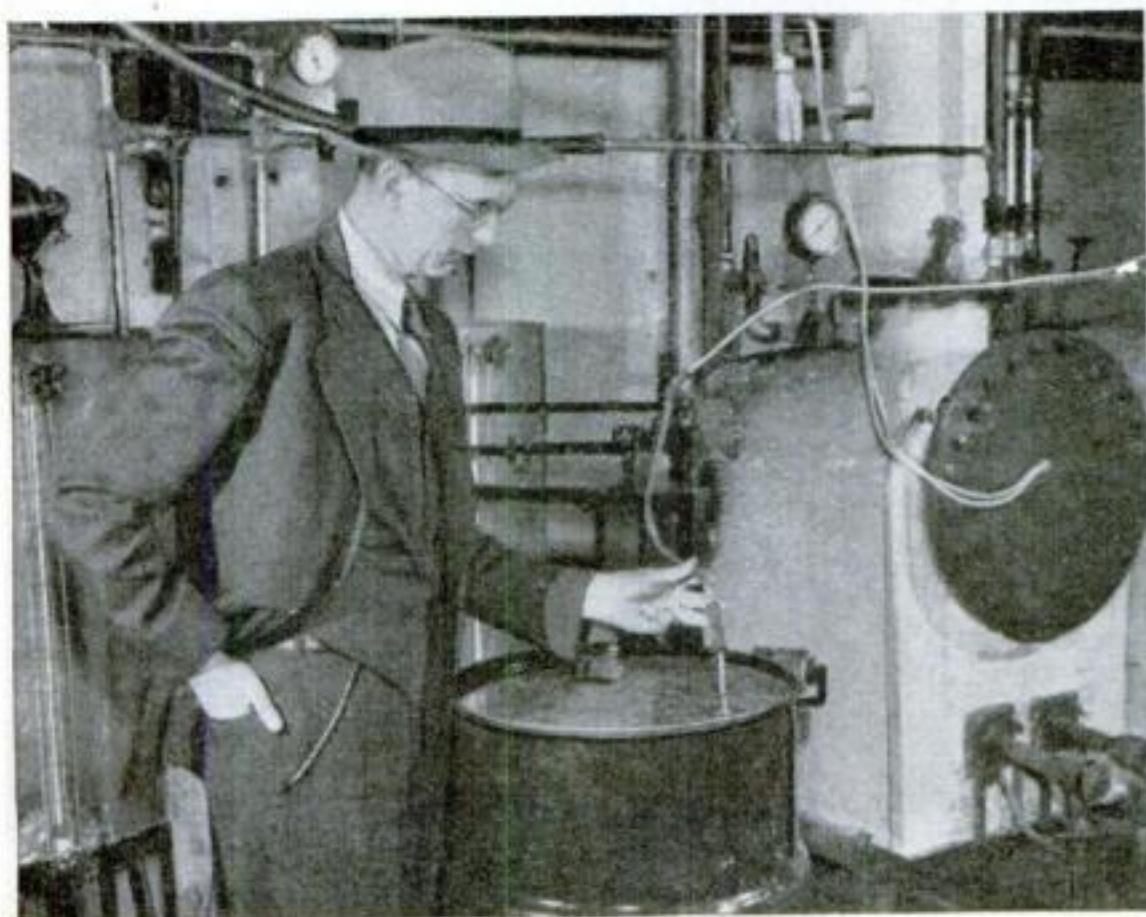


The chemical process that makes gasoline from coal. Ten to 15 gallons a day are produced experimentally

at Pittsburgh in action. Full-est coöperation of the laboratory staff made it possible for Bill Morris, staff photographer, to take these exclusive views while an actual run of synthetic gasoline was in progress. Lying on the floor of the "pill box," he snapped a worker inspecting a tall reaction tube as a compressor built up its pressure to uncomfortably near the danger point. Later, in the room containing the fractionating towers, his camera caught the finished gasoline coming from one of their outlets.



Dr. L. L. Hirst sniffs some of the first American synthetic gasoline. Shelves hold other products of coal



It comes out here. The liquid trickling from the tube is gasoline fresh from one of the fractionating columns

GUS solves an army job

The Brains of the Model Garage rarely had to help on a job his grease monkey tackled. But Harry still knows where to turn for help on the general's car!

SEVERAL of us regular customers of the Model Garage have a habit of dropping in on Gus Wilson a couple of afternoons a week, after we've finished work, and sitting around his shop talking about this, that, and the other thing until it's time to go home to our dinners. Gus always seems glad to see us, but he goes right on with the job he's working on, and as often as not his contributions to the conversation come from underneath a car.

One afternoon, a half dozen of us happened to blow in, and by half past five the shop was full of tobacco smoke and conversation. We were talking about whether it is cheaper to turn in your bus for a new one every year, or to hang on to it until there's maybe seventy or eighty thousand on its clock.

Gus had been washing up. Now he pulled

on his coat, filled his pipe and fired up, and came over and perched on the edge of his workbench. "What's the use of wasting your breath arguing about whether you should turn in your '41 model for a '42 model?" he wanted to know. "There mayn't be any '42 models. Likely as not the tool-makers will be too busy tooling up airplane and tank and gun factories to have any time for retooling the automobile plants. But, anyhow, no matter how long you keep a car, it's dead certain that you can save yourself both trouble and dough by taking decent care of it."

He reached into his inside coat pocket and pulled out a sheet of paper. "Here are some figures that'll help to show you what I mean," he went on. "I copied them out of an American Automobile Association report because I'm on the spot for a talk at the Kiwanis Club luncheon next week, and I've found that whenever you've got to stand up on your hind legs and expose your ignorance the best thing you can do is put down a nice thick smoke screen of figures between you and your audience. . . . Well, anyhow, here's the dope. The Three A's figure that in a year out-of-luck motorists put in over four million emergency road-service calls because of battery trouble—which with a little care and common sense



"Corporal Godfrey to you!" a voice said, and the Model Garage's former grease monkey advanced into the light

usually is easily preventable. They also figure that there are over three and three quarter million calls caused by ignition failure—over a million by starter trouble—over a half million by brake trouble. All that grief isn't the result of carelessness, of course. But if you think that a whole lot of it isn't, listen to this one—over a million and a quarter calls were the result of drivers running out of gas!"

Gus looked around triumphantly. Pretty soon George Knowles said: "Well—so what? What are you driving at?"

"What I'm driving at," Gus told him, "is the fact that car owners, whether their cars are old or new, could escape a lot of inconvenience and unnecessary expense if they'd learn to take better care of their busses than most of them do. If they'd just use their heads they'd spend a little money on preventive service—for check-ups and adjustments and the replacement of badly worn parts—that would keep their cars from breaking down. Before many months a lot of them may even have to roll up their sleeves and do some work themselves. There's going to be such a demand for mechanics that auto repair shops and service stations are going to have trouble handling their work—same as we have had since Harry Godfrey got called out with his National Guard regiment and we had to take in a green kid to replace a fellow who'd worked enough to develop into a real good mechanic."

"How's he doin' in the army?" Ez Zacharias asked. "Say, that kid Harry. . ."

"Corporal Godfrey to you!" a voice behind us said, and the Model Garage's former grease monkey walked into the circle of light from the drop lamp wearing a wide grin and an army uniform with brand-new corporal's chevrons on it.

We all shook hands with him and wanted to know how he liked working for Uncle Sam.

"Swell!" he told us. "Much better than sweating my heart out for this old slave driver Gus Wilson!"

Gus grinned. "When did you get those stripes?" he demanded. "That's fast work!"

"They gave 'em to me yesterday," Harry said, "and they're apt to take

'em back tomorrow. I'm in dutch, Gus. They promoted me when they gave me the job of driving a Regular Army general—and now I can't keep his car running. Is my face red!"

"Aw, don't let a general get your goat!" Zacharias snorted. "I know 'em—when I was in the Army they was a dozen for a dime. They're always hootin' and hollerin'—but what of it? Nothin' of it! Ever since I turned in my uniform I've been waitin' for a chance to tell one of them brass hats where to head in!"

"Don't pay any attention to Ez—he's just a sorehead," Gus said. "What's the matter with your general's car, Harry?"

"That's the matter—I don't know what's the matter with it," Harry told him. "This morning she wouldn't start. I checked her over. The gas feed, battery connections, switch, coil, and condenser all were O.K.,



Gus raised the car's hood. "I don't often recheck after Harry," he observed. "It seems to me the trouble must be in a loose wire"

but I couldn't get a spark at the plugs. Then, after I'd fooled around with the points and worked the automatic advance on the distributor a few times, I got a good spark—but I don't know why. Next time I stepped on the starter the engine took off swell. I gave her a road test, and everything seemed O.K. So instead of reporting to the motor sergeant that the car was out of kilter, I started off with the general on one of his inspection trips. We hadn't gone five miles before the engine started acting up again. It would miss and go dead, but when I'd get it started it would run pretty good for a while. It's been doing that all day. Half a dozen army service men have tried to fix it, but they can't locate the trouble."

"Where's the car?"

By MARTIN BUNN

Gus asked eagerly, scenting an interesting job.

"Out by the gas pump," Harry said.

Harry drove the car into the shop—a two-year-old sedan painted gray-green like all the Army's cars, and with a tag with two stars on it on its front fender. Harry hopped out and hurried around and opened the door—and darned if his general didn't get out! We were all so surprised that no one said anything. Somehow we'd never thought of the general being in the car. He was wearing boots that you could see yourself in, and one of those uniforms that fit so that when you look at them your clothes feel too big for you. He had a stubby gray mustache and shaggy gray eyebrows, and you can take it from me that he looked plenty hard-boiled.

We stood there staring at him, and then Zacharias began making funny noises, so we stared at him instead. He'd spit out his chaw of tobacco and pushed his postman's cap from the back of his head over his eyes, and he was standing with his little fingers down the seams of his pants legs and his chest stuck out so far that the top buttons of his vest were pretty near popping off. He gurgled for a while longer, and then he got out: "Private Zacharias, sir. Will—will the general have a chair?"

One side of the general's mustache sort of twisted up, and then he grinned. "Handley's my name," he said. "Glad to meet you, Mr. Zacharias." He held out his hand, and Ez grabbed it and then dropped it as quick as if it had been a hot spark plug.

"This is Mr. Wilson, sir," Harry spoke up. "He's the best trouble shooter this side of—I mean, sir, he's . . ."

"I know what you mean," the general said. He looked at Gus, and for a second his eyes rested on the silver veteran's button in his coat which shows that he was wounded in World War No. 1. Gus always wears it, although we've never been able to get a word about his war experiences out of him. General Handley grinned again and shook hands with Gus and said: "Mr. Wilson, I see that we've both fought and bled and been scared darn near to death for our country!"

Gus laughed and said that getting hit had been his own fault because he'd forgotten to duck. "I'm sorry you've been held up by this car trouble," he added. "I'll try to locate it

and get it fixed in a hurry. In the meantime—"

The general broke in on him. "In the meantime," he said with good humor, "I'll try to learn something useful while I watch you trying to make good on the big build-up that Corporal Godfrey has been giving you."

Gus raised the car's hood. "I don't often recheck after Harry," he observed, "but it seems to me the trouble must be a loose wire. Let's see, now." He tested the battery connections, the condenser, the points, and even the terminals of the flexible wire in the distributor. "No, Harry was right," he said. "The wiring checks O.K." Then he got in the car and stepped on the starter. The engine started smoothly.

"She's done that with me about twenty times," Harry said. "The trouble is that she won't keep on running like that. You'd better give her a little road test, Gus."

Gus nodded, and backed the car out of the shop. It ran without a sputter. Just as he cleared the shop door a car which had been standing at the gas pump came around the driveway, and he had to stop and let his engine idle until it had passed. Then he stepped on the gas—and the engine began to miss. After a few seconds it cut out entirely. He started it again, and as soon as he speeded it up it cut out again. Finally it quit altogether, and we all—including the general—pushed the car back into the shop.

Gus got out looking puzzled. "Looks to me as though she wasn't getting gas," some one suggested.

"No, it isn't that," Gus said. "When an engine quits like that it isn't a sign of lack of gas."

He checked over everything again. Again all the wires seemed good. "It must be in the distributor," he decided. "And there's only one certain way to check a distributor—get it off the car and on the workbench where you can really get at it."

We all sat around and watched as he and Harry took off the distributor, took it over to the bench, tested its points, and removed

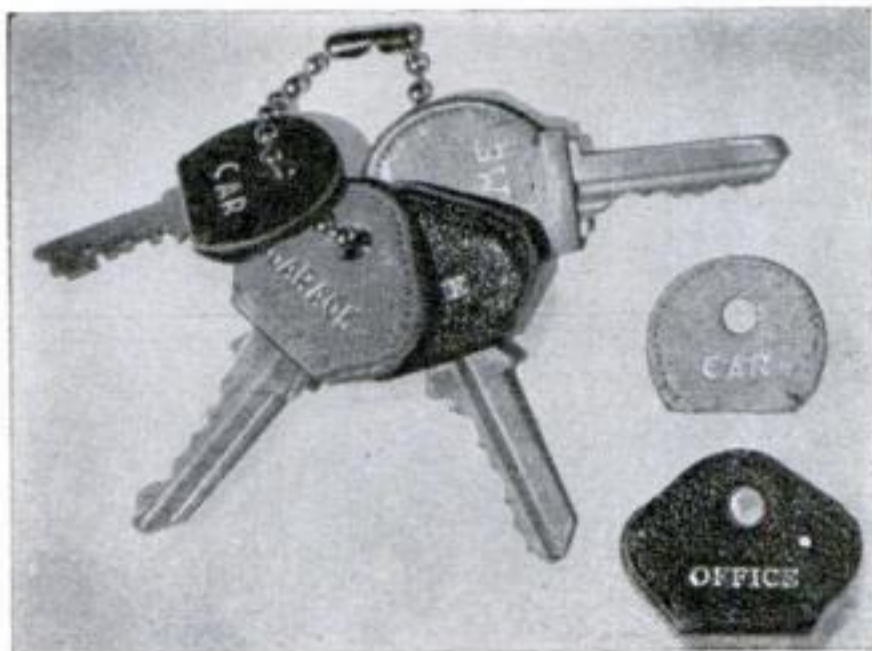
the flexible-wire "pig-tail" connecting the plate to the distributor terminals. Again everything checked.

Gus looked really stumped—something that we haven't seen him do very often. He scratched his left ear with his right hand as he stared at the distributor. That must have given him an idea, for he (*Continued on page 222*)

GUS SAYS:

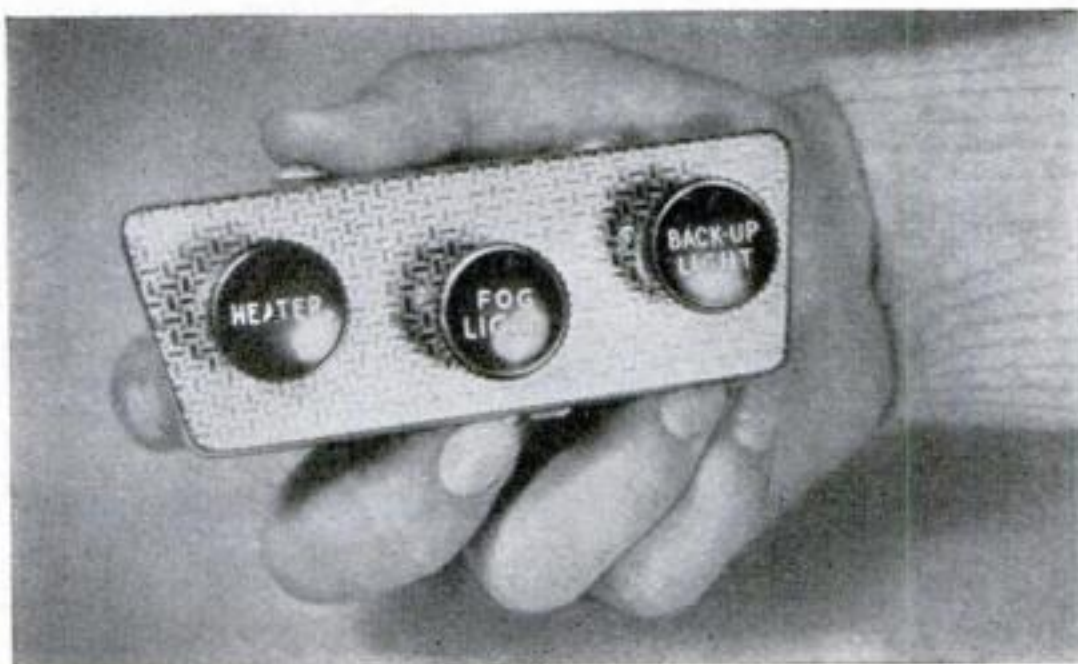
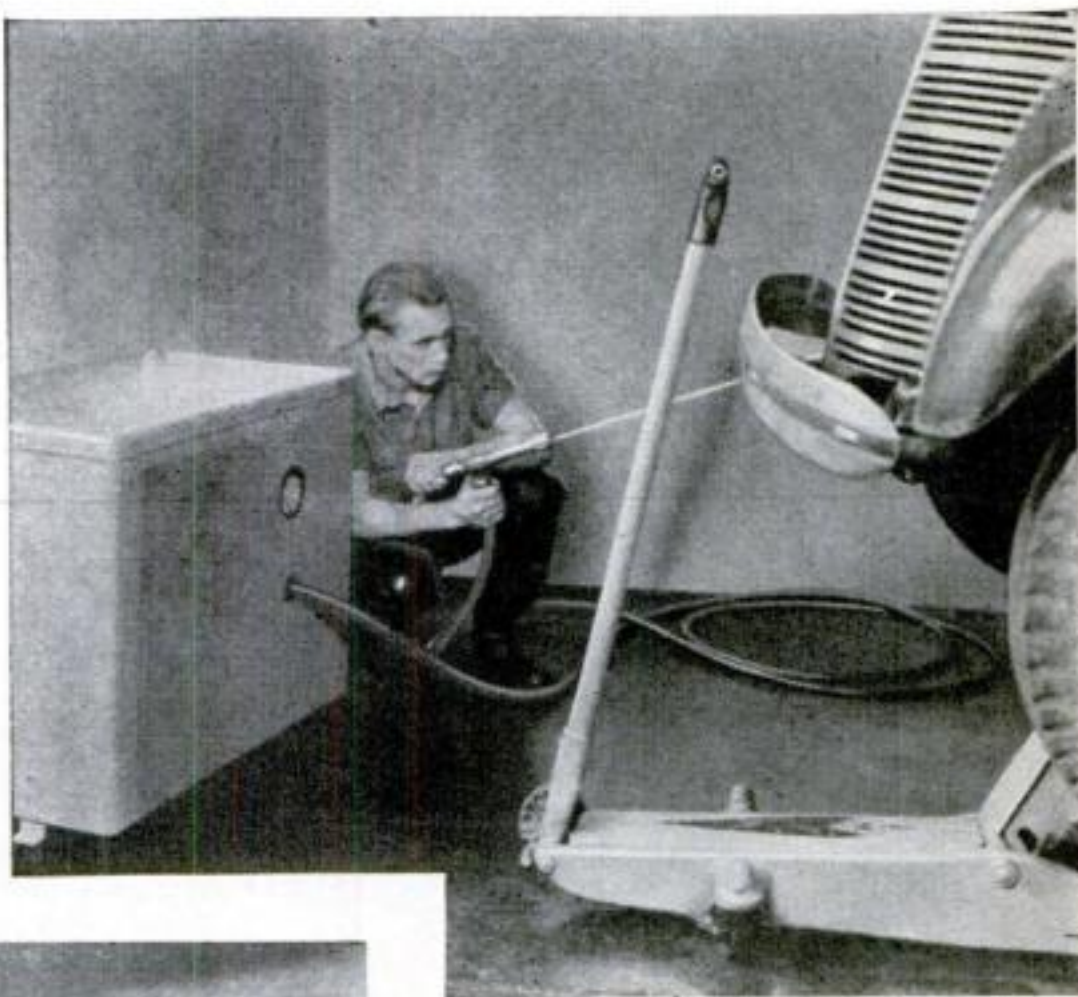
Just the other day a fellow was bragging to me about the fact he never put chains on his car. "Drive better without 'em," he said. An hour later, I was pulling him out of a snow bank with the wrecker. Sure glad it was nothing worse!

Auto Ideas

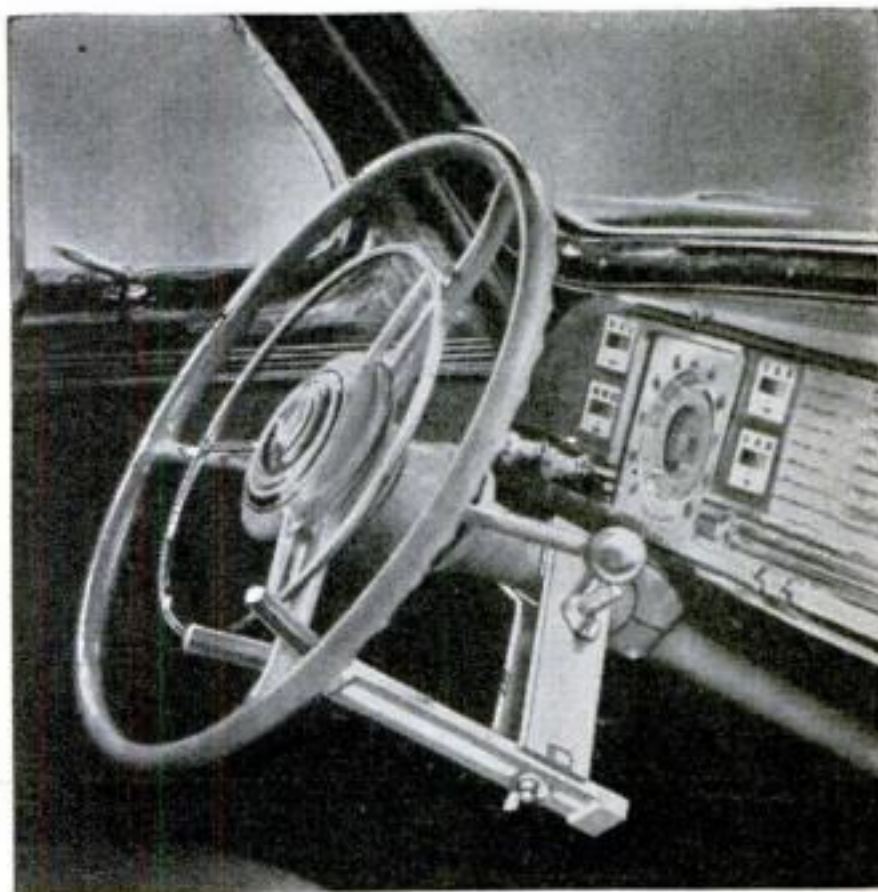


CAPS FOR KEYS, bearing lettering stamped in gold, will tell you which is for the car, garage, office, front door at home, etc. They are made in assorted colors and come in sets of four to six. Used in a car, they will prevent dangling keys from rattling. They fit keys of any standard variety

CAR WASHER. In keeping with the modern trend in garage and service-station equipment, the compact car-washing unit at the right is housed in an attractive metal cabinet. Its high-pressure pump delivers four gallons of water a minute at a pressure of 325 pounds to the square inch



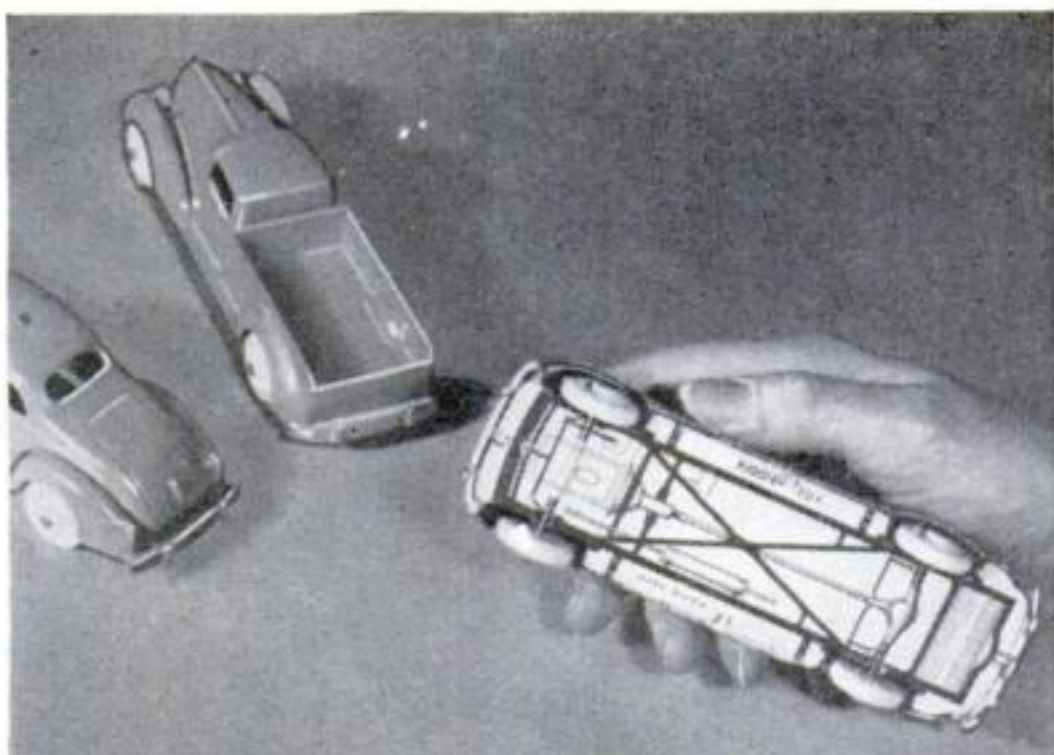
ACCESSORY SWITCH PANEL takes care of the extra electrical appliances you may mount on your car. Knobs of red plastic, set on a chromium plate, bear lettering to indicate the accessories they control. Only two screws are required to mount the panel along the bottom edge of your dashboard, where they'll be handy while you drive



STEERING-WHEEL LOCK. Used in towing a car with its rear end up, this adjustable lock has a leather-lined clamp for attaching to the steering column, and hard-rubber bars to grip a wheel spoke

Toys Teach Children How Cars are Built

DESIGNED to show children where the mechanical parts of a car are located, toy automobiles are now available with a worm's-eye view of a conventional car lithographed on the sheet-metal bottom of the toys. Axles, the engine, transmission and clutch housing, drive shaft, springs, and other parts are all shown in their proper positions on the chassis. The six-inch vehicles have quiet-running wooden wheels, and are available in four body types.



Undercar parts are clearly lithographed on these toy autos

Window Fix-It Kit

REPLACEMENTS for the parts most apt to wear out in car-window regulators—pinions, springs, washers, rivets, and the like—are all contained in inexpensive kits now marketed for several makes of cars. The manufacturer claims that it takes less than ten minutes to rebuild worn-out regulators with the kits, at low cost.



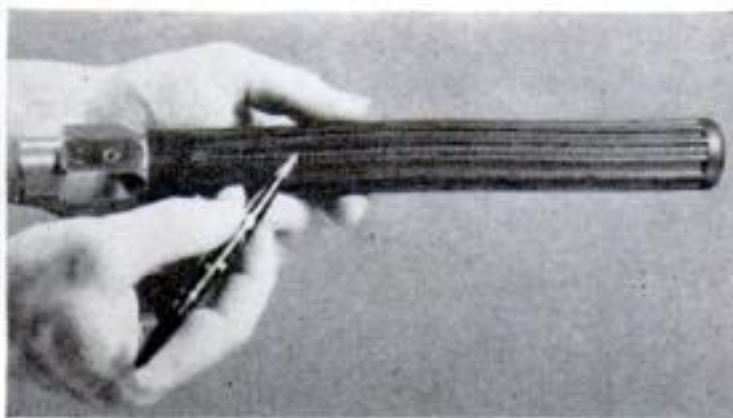
The kit and parts for repairing worn-out window regulators

Flexible Gas-Hose Nozzle of Synthetic Rubber

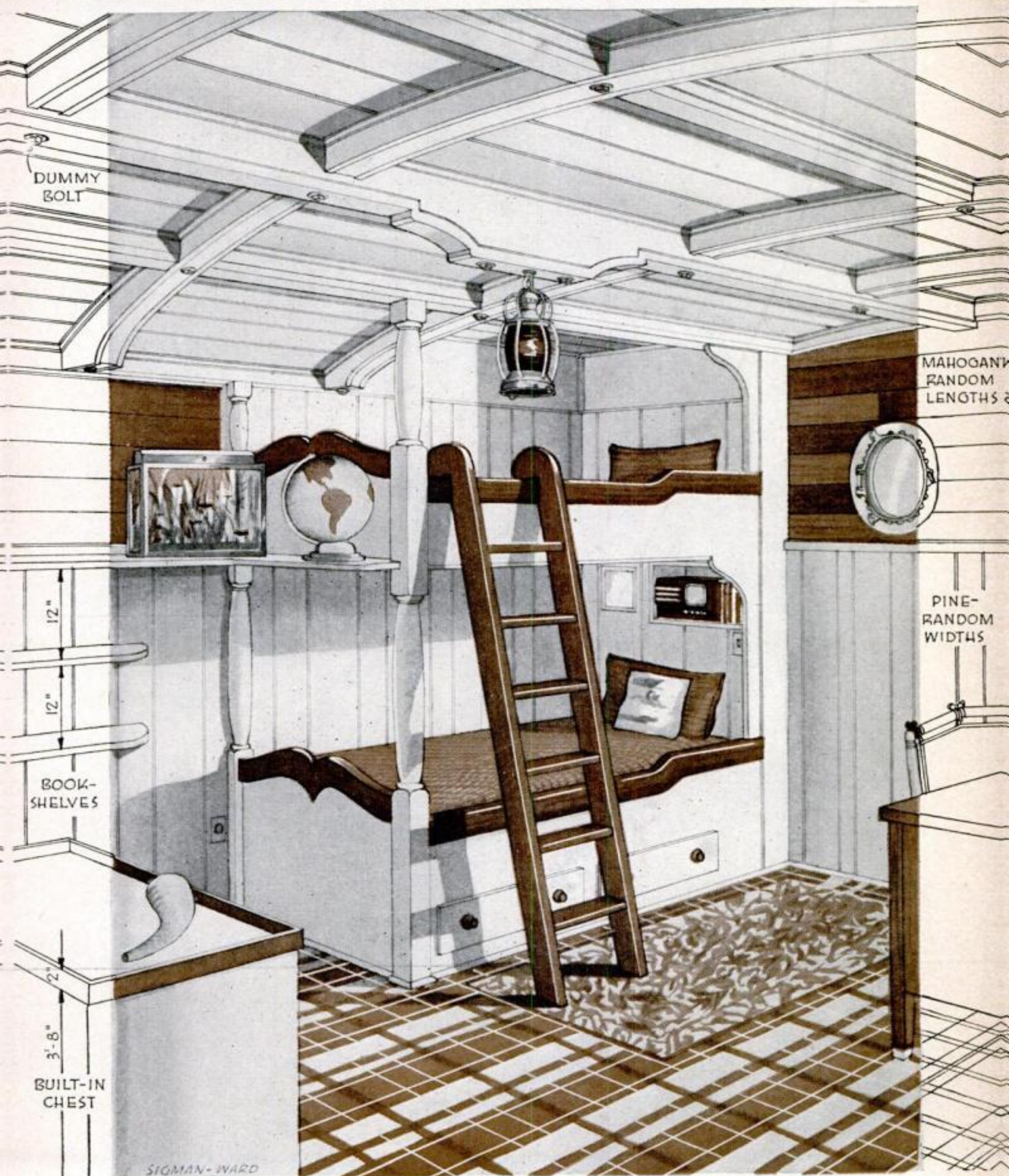


This flexible nozzle can't scratch body paint. The pencil points to one of the metal springs that draw off static

SYNTHETIC rubber, unaffected by gasoline, oil, heat, cold, sunlight, or the air, forms the material for a gasoline-hose nozzle developed after three years of research. The synthetic material is itself a conductor of static electricity. Further protection against fire caused by static sparks is provided by four small wire coils embedded in the nozzle. Sixteen ribs are molded into the tube's outer surface to vent air from the filler pipe as gasoline flows into the car's gas tank.



HOME *and* WORKSHOP



A Room for Bobby

NEXT PAGE

Bobby McBride in his bunk intent on a stirring tale of the sea. His dog Koko likes the room just as much as Bobby. The radio is within arm's reach, and there is everything in the cabin a boy could wish



I Build a Room for Bobby

By **CLIFFORD McBRIDE**

Creator of the Comic Strip, "Napoleon and Uncle Elby"

THE very first word uttered by my infant son was "Boat!" Naturally, his mother and I were elated; this was so much more intelligent than the customary "da da" or "goo," but we didn't attach any particular marine significance to it at the time.

As events piled up in subsequent years, however, we realized that first word was prophetic, because Bobby has been boat-minded ever since. Even on his second Christmas he ignored a high-stepping hobbyhorse and clamored for a ten-cent sloop hung high up on the tree, and it wasn't long before he was whacking together slab-and-shirt-tail schooners to sail in the fishpond. Next he took to paddling a canoe around Big Bear Lake, with visibility somewhat limited because he could barely see over the gunwales. And so it went, from outboards to speed boats to a trip in a 110' yacht, always on the bosom of the deep whenever he could manage it.

Finally the time came when school kept

him ashore most of the year, and the best compromise between life on the high seas and a land-lubber existence appeared to be a ship's cabin right in the house, which you see complete on these pages.

I believe I had as much fun planning and working out the details as Bobby does now, building his ship models or snug in his

bunk listening to the waves (Altadena, Calif., rain) pound at the portlights. A clever craftsman of the old school helped me with the construction, but I suspect my sketches puzzled him at times because he interpreted them literally, and when my pencil stroke carried beyond a wall he followed right along after it. Notwithstanding, the whole worked out in a most satisfactory manner.

The treatment is best adapted to a small room, say 10' by 12', and the sectional view in Fig. 1 shows the compact arrangement and arched beams. Note the high wainscoting installed vertically, in random widths; and above it, the horizontal mahogany pieces in random lengths. The contrast of the latter in dark stain against the white enameled wainscoting is very effective.

If the original wall permits, the wainscoting and mahogany can be nailed directly through the plaster to the studs, which are located by sound, that is, by tapping lightly



To guide in building the room, Clifford McBride, who is shown below at work in his Altadena, Calif., home, made sketches similar to the one illustrated. His famous comic-strip character, Napoleon the dog, doesn't quite know whether he likes the ideal

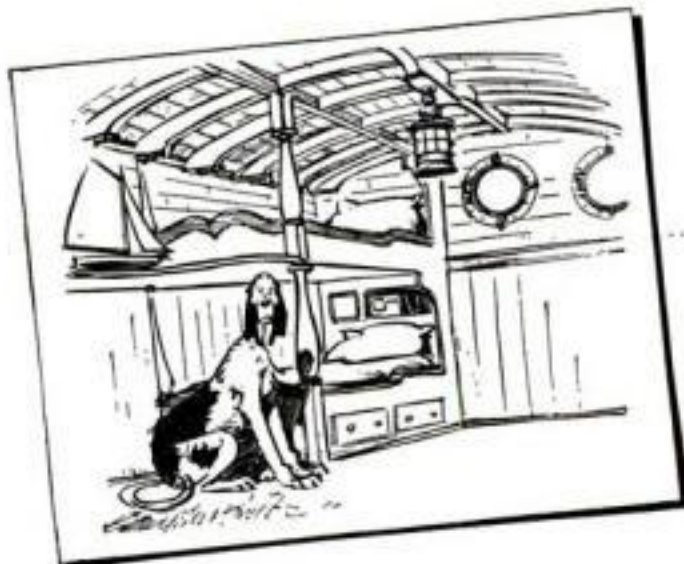


with a hammer. In standard construction, studs are spaced 16" apart on centers. Furring strips may be nailed to the studs first, if preferred, and the wainscoting over them.

Construction of the curved beams is simpler than appears in the photographs. They are built up with five separate pieces of $\frac{3}{4}$ " stock (sectional view, Fig. 2), with an extra cheek piece on each side to which the horizontal ceiling boards are nailed. Some material could be saved by cutting filler blocks in place of the inner boards. The joints are covered with molding. Here and there, toward the center of the arch, the beams are secured to the ceiling joists above with long lag screws, if possible, and the heads concealed with wooden plugs.

There are six curved beams, counting those at the ends, and five straight ones running at right angles to the former. The straight ones are of the conventional box type, the central beam being deeper than those on the sides. There is a further drop where the ship's lantern is hung (Fig. 3).

This lamp, by the way, actually swings. A concealed mechanism causes it to sway gently as in a rolling sea. We have a lot of fun with this when showing the room to visitors. With two or three of my friends "in the know," I will start swaying in unison with the lantern until the startled newcomer



begins to think the room itself is on trunnions and rolling too.

The mechanism is operated by a small electric motor which drives a worm gear running in oil. A sliding arm is connected by a link to the rod on which the lamp is hung. The latter swings in a ball-and-socket joint, and a counterbalance above makes the motion much smoother. Since the motor is some distance from the lamp and the gears run in oil, the sound is reduced to a minimum and is not perceptible, especially through the double ceiling. Access to the motor is through a trapdoor in the closet.

A plan of the beam arrangement is given in Fig. 4. Note that one beam is cut off over the bunks to give more headroom in the upper. Incidentally, on a ship these beams are called "carlins." The arrangement of shelves, dresser, bunks, and so on is given in the floor plan, Fig. 5; and you will note on one side a French window instead of portholes. This is the only concession to conventional design, and was left in to give

5 1/4" x 3/4" MAHOGANY IN RANDOM LENGTHS, SPLINED END JOINTS

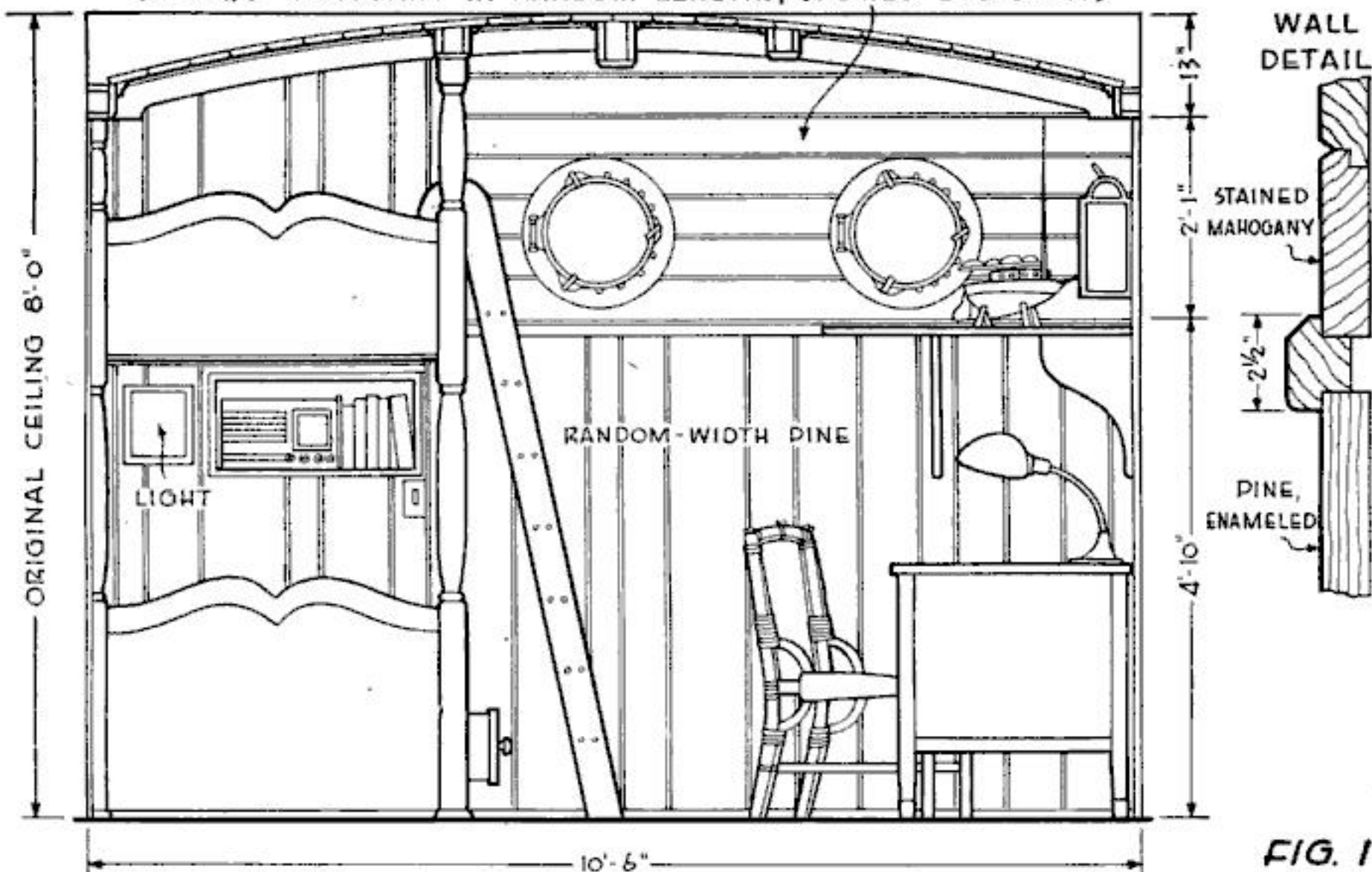


FIG. 1

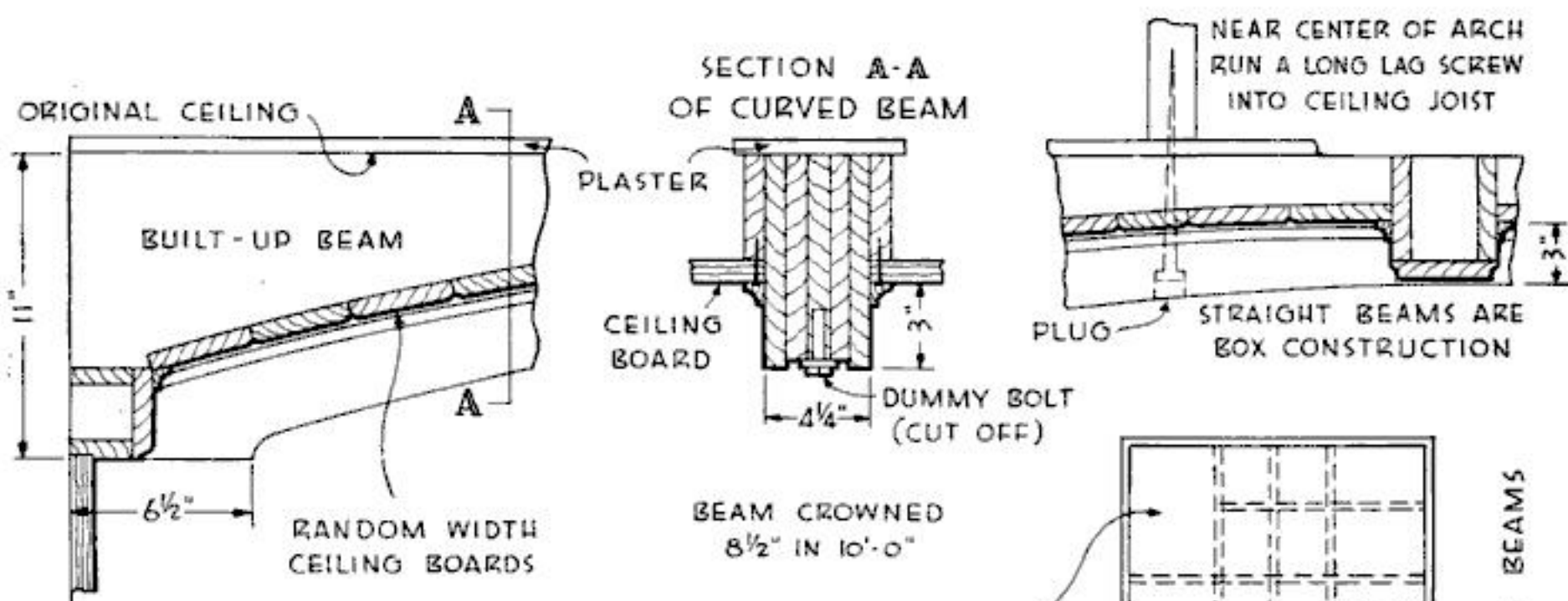
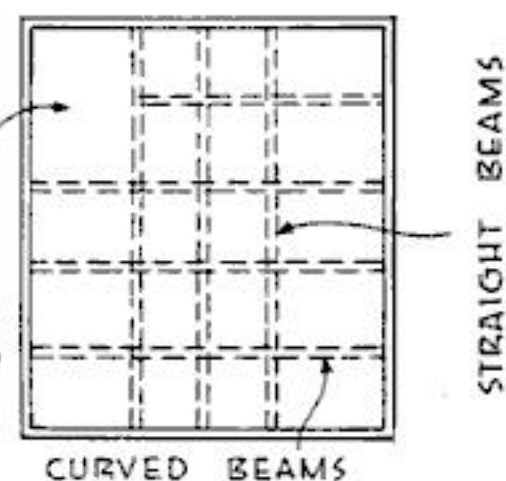


FIG. 2

NO BEAM,
TO ALLOW MORE
HEADROOM OVER BED

FIG. 4



CENTRAL BEAM IS DEEPER THAN
THE OTHER STRAIGHT BEAMS, WHICH ARE 3"

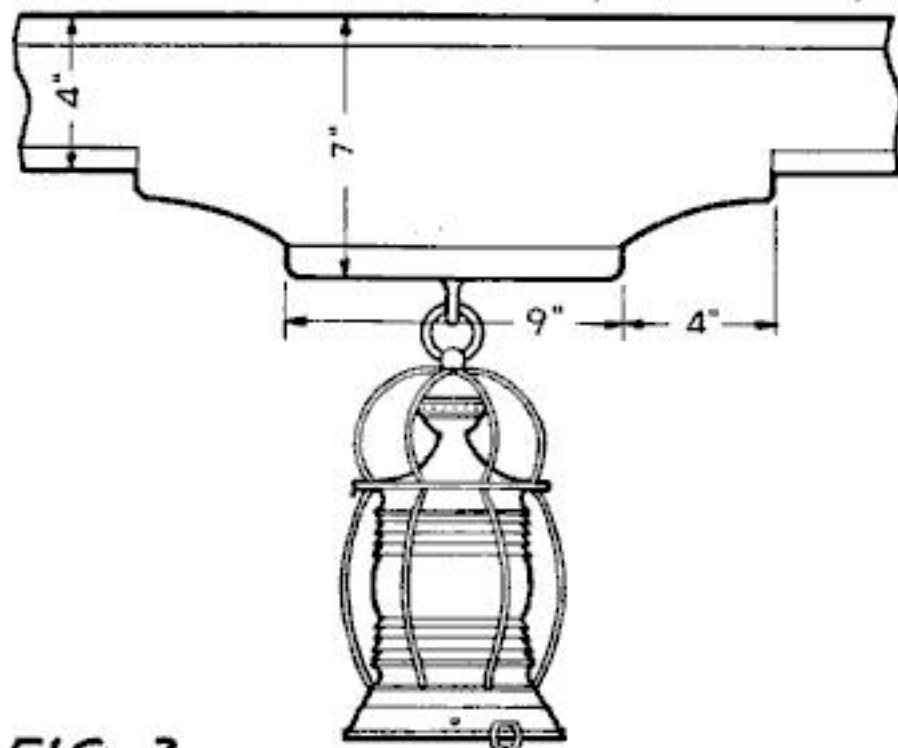
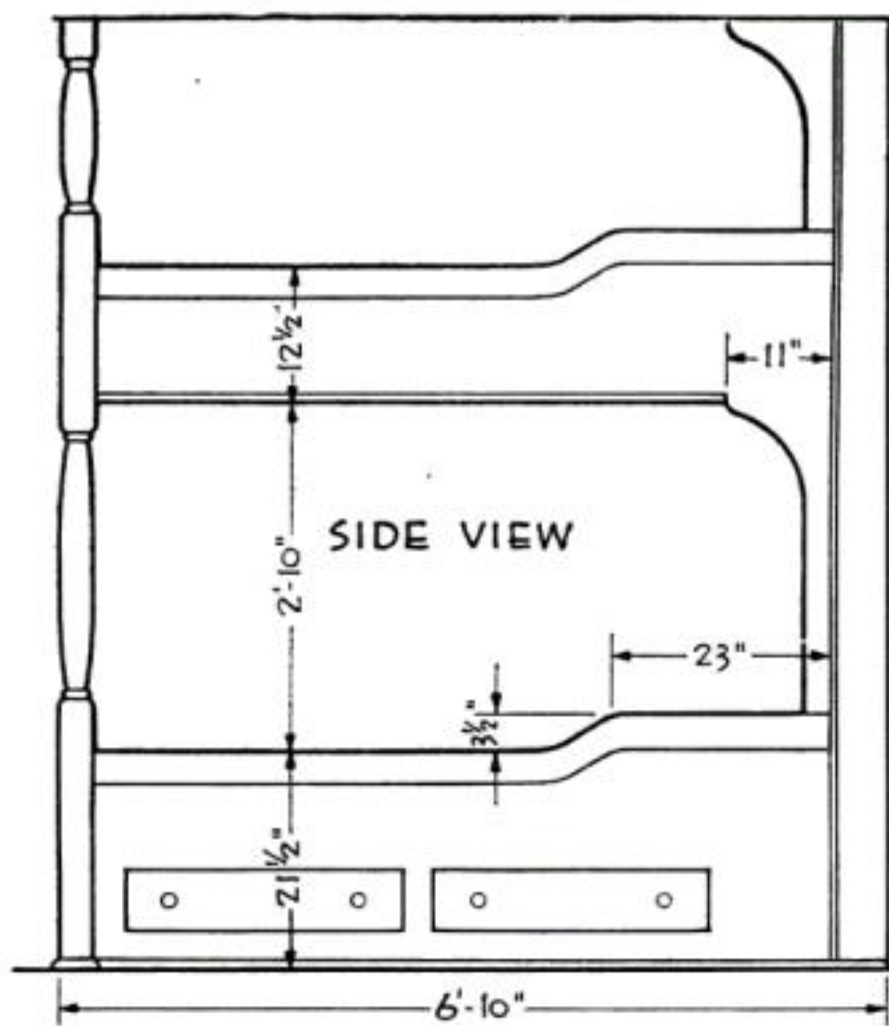
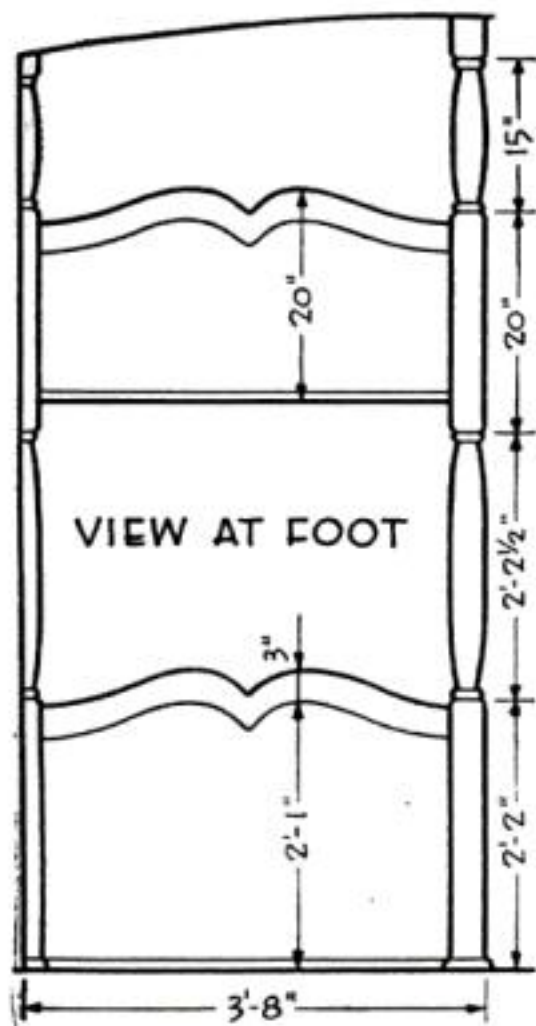


FIG. 3

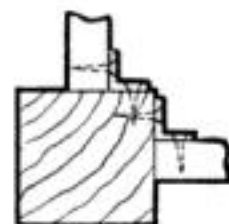


FIG. 5

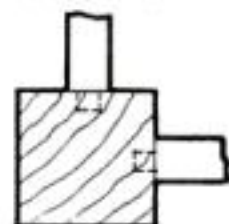


BELOW,
THREE TYPES
OF JOINTS
FOR POST, FOOT,
AND SIDE RAIL

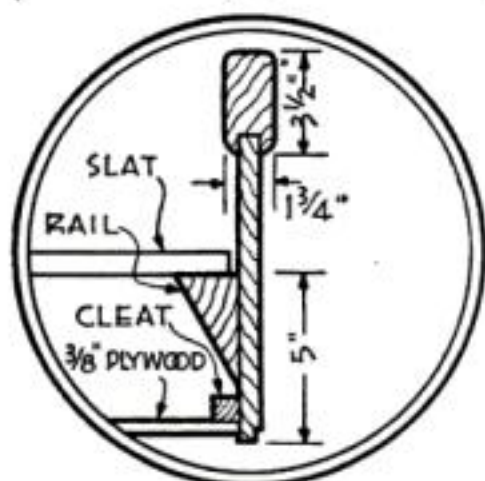
ANGLE PLATES



MORTISE & TENON

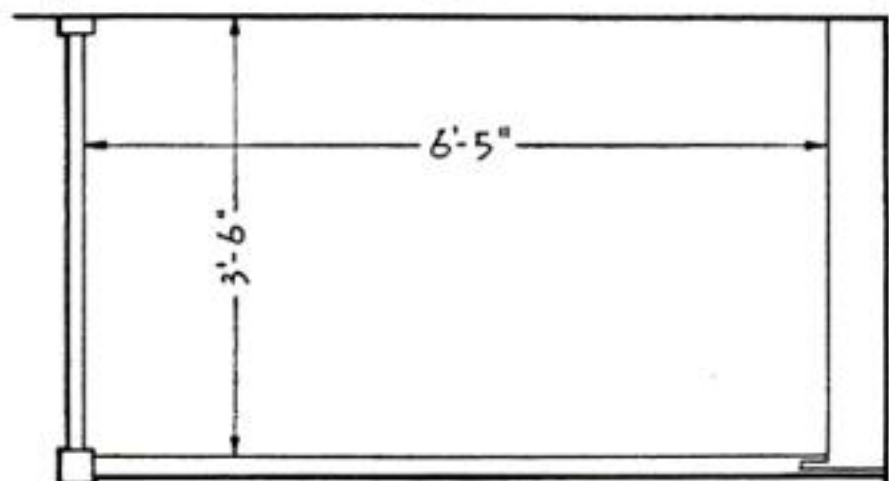


HARDWOOD CLEATS



SECTION THROUGH
SIDE RAIL
(UPPER BUNIK)

FIG 6



PLAN

FIG 7

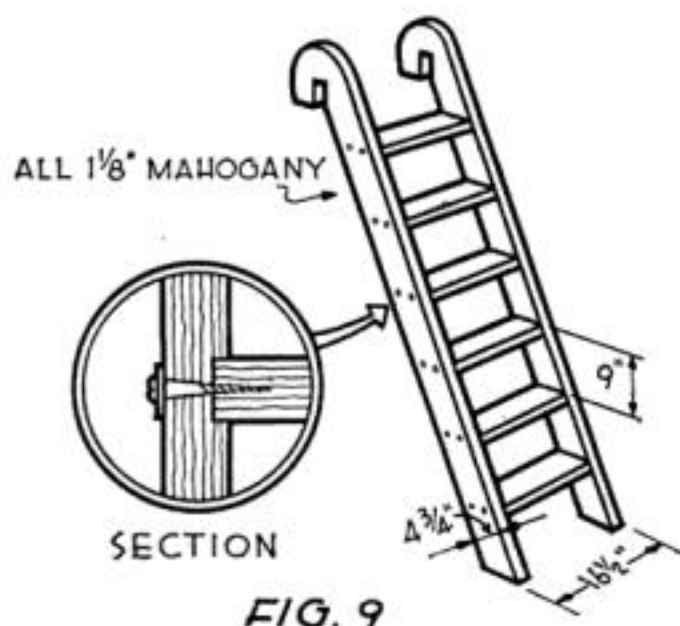


FIG. 9

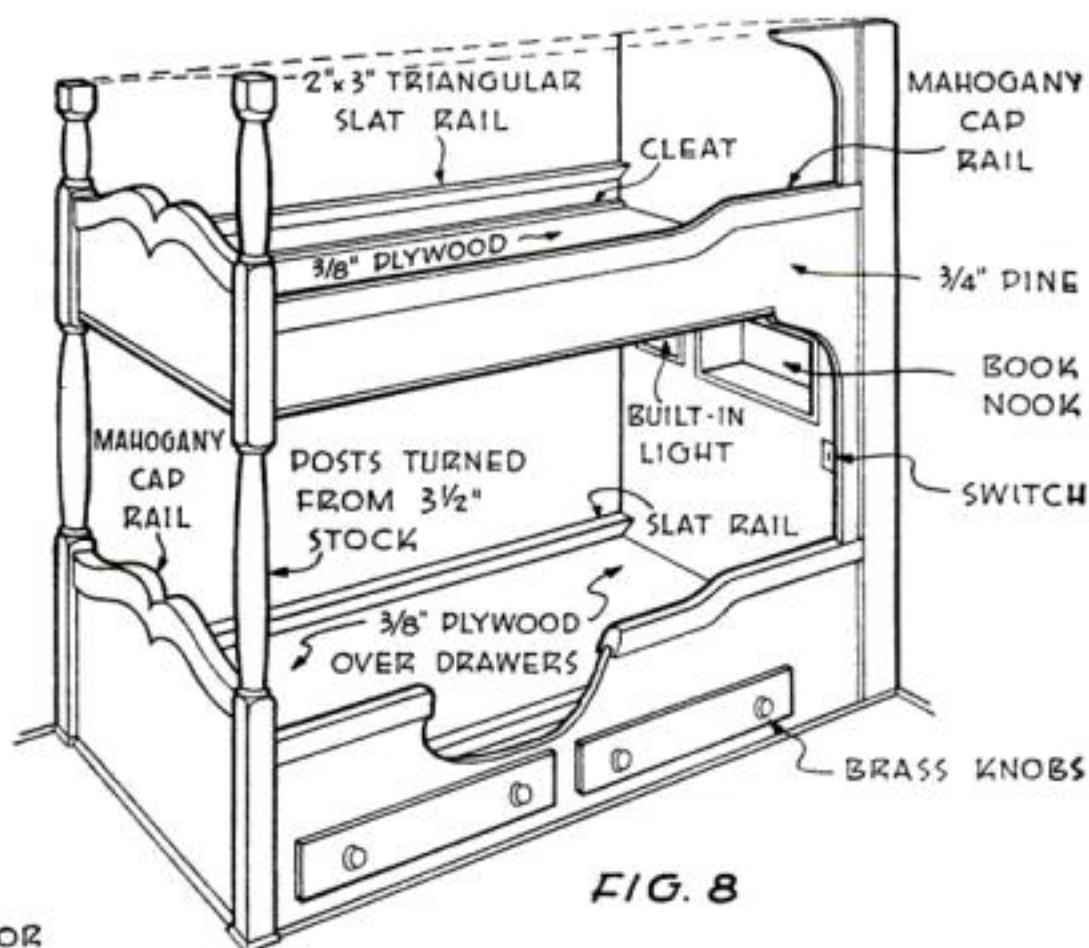


FIG. 8

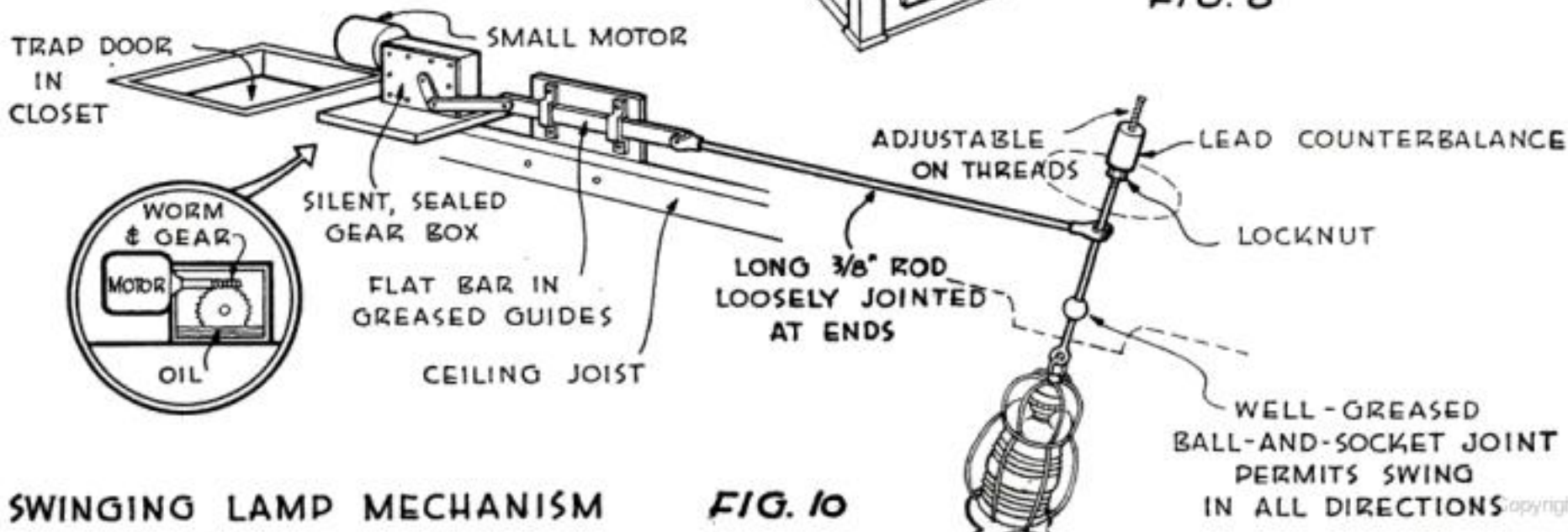
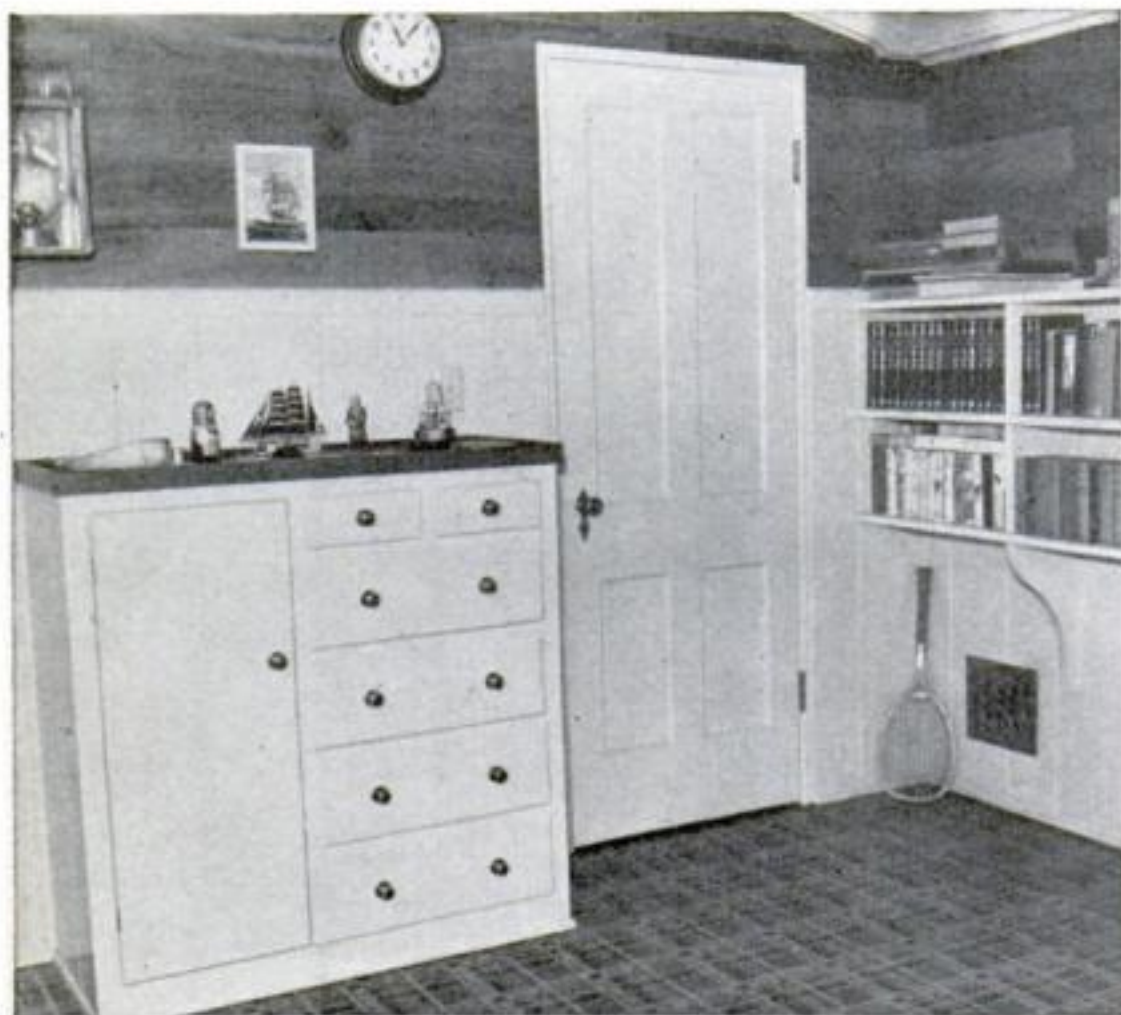


FIG. 10

SWINGING LAMP MECHANISM



A mahogany rail around the top of the dresser keeps things from sliding off in stormy weather, just as on a deep-sea windjammer



The wainscoting, with mahogany paneling above, is in random widths. Note the cabin lantern in the corner at left of books

The ship's lantern actually swings as if the cabin were rolling on the high seas. It is operated by a concealed mechanism driven by an electric motor, as shown in the drawings

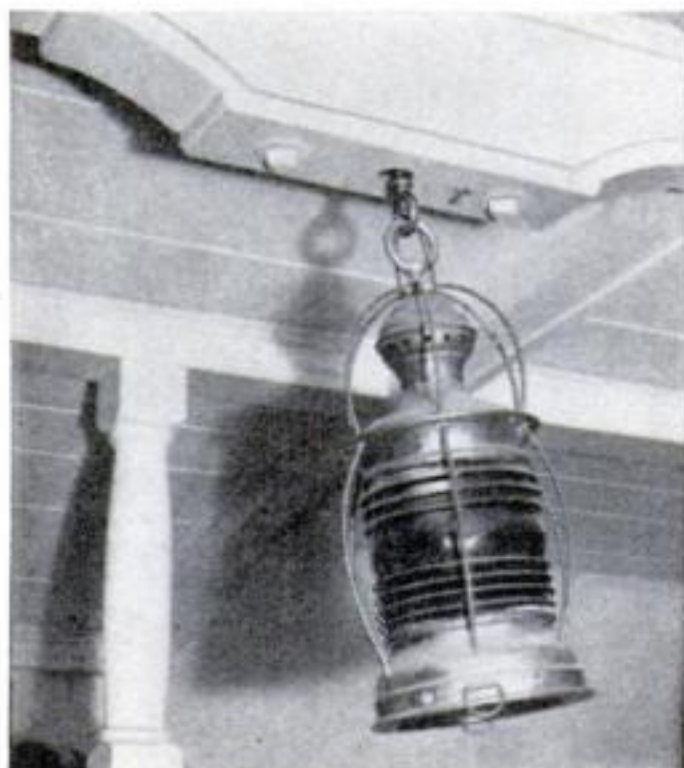
better light and ventilation than afforded by the ports.

The bunks are of simple construction and built to the general dimensions in Fig. 6. They were designed for standard twin-bed box springs, which rest on slats supported by an exceptionally substantial three-cornered slat rail, which is screwed and glued to the side member. Under the slat rails in each bunk is a panel of plywood which prevents dust and lint showering down on the able seaman below, and into the drawers.

Three types of joining at the post are shown in Fig. 7. Of course, the mortise-and-tenon makes the neatest job, and is permissible on a built-in structure. Steel angle plates, on the other hand, are the strongest.

A perspective of the bunk unit is shown in Fig. 8, complete with the book nook and built-in light. The latter is simply a recess covered with ground glass, giving bright illumination for reading—and entirely seaworthy. The mahogany cap rail adds much to the appearance of the bunks, I think. Drawers below are made large enough to accommodate linen or other items.

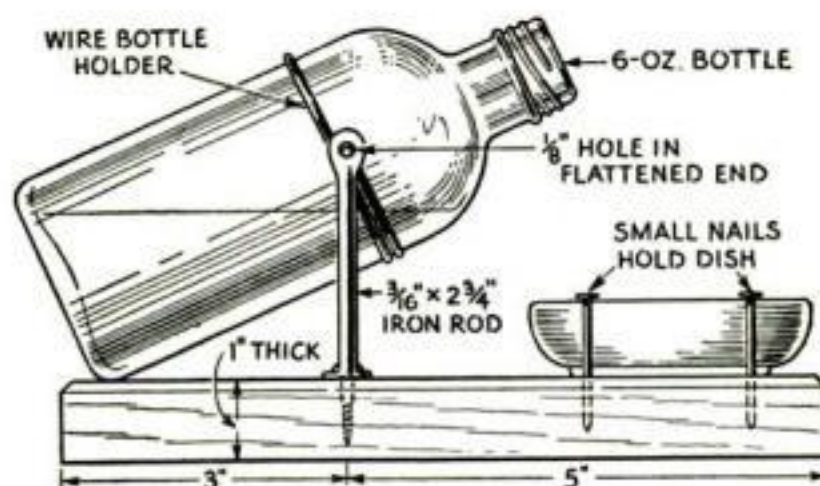
Shelves in two corners take care of a sizable nautical library, and in the built-in chest at the opposite end of the room from the portholes are stowed Bobby's tools and materials for model making.



Cat Quickly Learns to Pour Milk from a Tilting Bottle



DIFFICULT as it is to teach a cat tricks, she will quickly learn to use the amusing device shown. This is merely a bottle so mounted that it can be tilted to pour milk into a small dish. To familiarize a cat with the device, place one of her paws on the neck of the bottle and push it down until some milk runs out. After the cat drinks this, repeat the lesson.—EDMUND DOWLING.



Hot Soldering Iron Aids in Cutting Off Narrow Glass Strips

CUTTING glass, if it is thicker than usual, sometimes causes difficulty. This is especially true if a narrow strip has to be trimmed off one or more edges, because it is hard to break the piece off smoothly. One thing that helps is to bring a hot soldering iron into contact with the glass along the mark made by the glass cutter. The heat causes the cut to widen into an even crack, without leaving jagged or chipped places.—E. B.



WOOD BLEACH

[PAINTING]

A bleach that is especially valuable for obtaining light or blond finishes on cabinet woods used for craftwork and furniture projects can be prepared as follows:

Sodium metasilicate (water glass).....	16 oz.
Sodium perborate	1½ oz.
Water (boiling)	1 gal.

Apply this to the wood liberally with a brush. Let stand half an hour. Wipe off and rinse clean. After letting it dry overnight, sand the surfaces clean. This bleach is so powerful that if a second coat is given, it will usually leave the wood with a color ranging from bone to ivory white. That is true even on dark woods such as walnut.

\$1000 in Prizes

FOR TELLING US WHAT KIND
OF HOME YOU'D LIKE TO BUILD

HERE is a contest that will be really profitable for you to enter . . . win or lose. We want you to start thinking about the sort of house best suited to the needs of your own family. Get your ideas down on paper, send them to us, and compete for one of the thirty awards we are offering, as follows:

FIRST PRIZE—The services of an outstanding architect (or any architect of your own choice) to draw the plans and supervise the building of your home, or, if you prefer, a cash award of	\$500
SECOND PRIZE	200
THIRD PRIZE	100
FOURTH PRIZE	50
FIFTH PRIZE	25
25 PRIZES, \$5 each	125
TOTAL	\$1,000

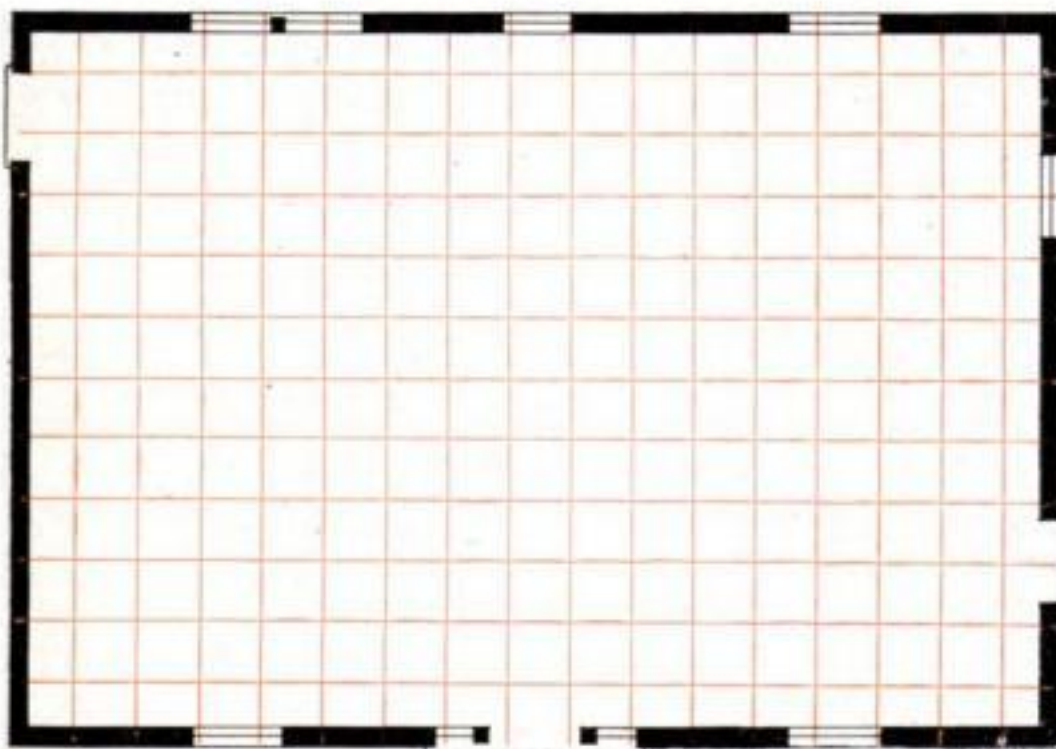
All the members of your family can share in working out the plans. Common sense and good judgment are the only essentials, not technical knowledge of the building trades or even skill in writing and drawing.

You will find the complete rules on page 157. To make it easier for you, we asked Henry H. Saylor, who has been one of the country's leading architectural authorities for many years, to tell how he goes about planning a house. This he has done in an accompanying article. In addition, Sigman-Ward have described ten different types of exterior walls to help you select the construction you would prefer for your home.

A blank floor plan has also been provided. You can lay tracing paper over this, if you wish, and work out various room divisions. When you have a satisfactory arrangement for each floor, the plans can be redrawn larger and more clearly, and submitted as

your entry along with the other information mentioned in the rules. You are under no obligation, however, to use a house of this particular shape and size. Neither do you have to use the conventional architects' and builders' symbols shown on page 157, although they do form a sort of convenient shorthand.

Don't fail to start work right away and send your entry in as promptly as possible. The contest closes April 15, 1941.



EACH SQUARE EQUALS 2'-0"

If you are partial to a house of the New England Colonial type, you can lay tracing paper over the accompanying blank floor plan and try out different room arrangements



How an Architect Designs a House

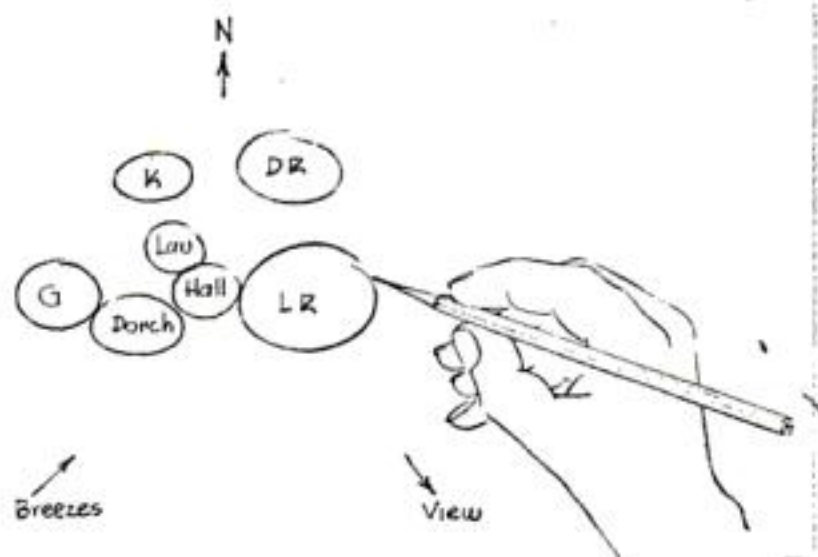
By **HENRY H. SAYLOR, A.I.A.**

Registered Architect and Associate Editor of
"The Architectural Forum"

AN ENGINEER called me in the other day seeking an answer to the question of how one goes about planning a house.

"I know how to draw to scale and I think I know what I want in a house," he said, "but frankly I'm stuck. Every time I get most of the pieces together in this jig-saw puzzle, I run across one that doesn't fit, and have to start back at the beginning."

The engineer's big mistake was in trying to do last things first. If I were given the job of designing an automobile—which Heaven (Continued on page 154)



In planning a house, work from the inside out. First sketch crude circles to represent the rooms and their relation to each other and to the plot

Exterior House Walls 10 STANDARD METHODS OF CONSTRUCTION

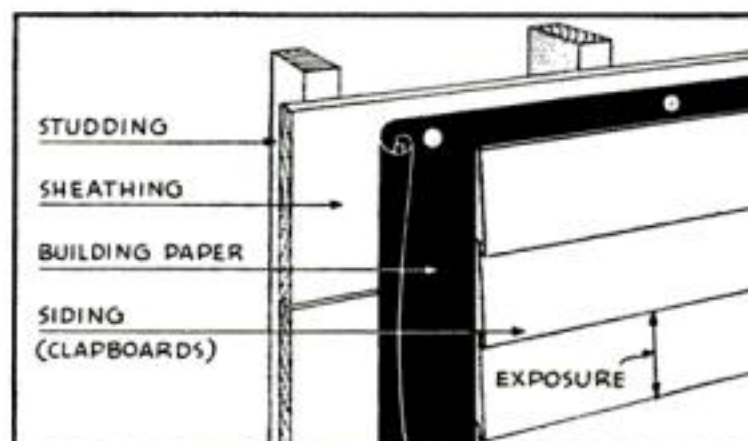
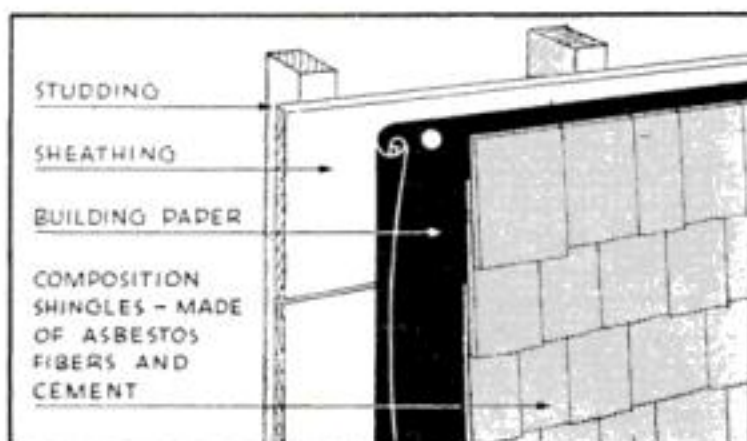
To GIVE you a better idea of some of the more common types of wall construction used for small houses, we asked Carl T. Sigman and William J. Ward, Jr., who hold top rank among architectural illustrators, to sketch ten different varieties and add their own comments as to the characteristics of each.

When the foundation of a house has been finished (unless it is to be of solid brick or other masonry), the carpenters anchor a heavy wooden sill on top. To this they nail 2" by 4" vertical wall studs, placed, as the architects say, "16"

on center"—that is, 16" from center to center, or approximately 14" apart. When these are all set up, the sheathing, which is usually $\frac{7}{8}$ " boards or 4' by 8' wall boards, is nailed to the outside of the studs. Wall board is generally applied horizontally, but $\frac{7}{8}$ " board sheathing is frequently nailed diagonally to the studding in order to brace the wall more securely. Then comes waterproof building paper, and finally brick or stone veneer, or siding, or shingles, or any combination of these, depending on the owner's wishes or architectural advantages or economy.

1 Composition asbestos shingles are made from asbestos fibers and Portland cement under great pressure and come in various colors. Certain types have all the texture of weathered wood shingles and, in addition, they will not rot, corrode, or split. They are fireproof, cannot be attacked by termites, and never require paint. Asbestos siding is also obtainable

2 Perhaps the most usual form of outside finish of a frame house is wood siding or clapboards. This comes in various widths, from very narrow to very wide, depending on the artistic effect the architect has in mind. Siding may be rabbeted or notched, as shown, or simply beveled. Architects usually specify siding as so many inches "exposure to the weather"



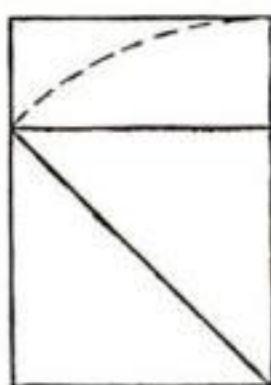
forbid!—I wouldn't dream of starting with the shape of the doors or the height of the running board above the ground. I'd get at the works. I wouldn't even bring out the drawing instruments at first. A piece of scratch paper or the back of an old envelope would serve to make a list of the essentials—motor, transmission, cooling system, brakes, steering, and so on. Then I'd begin to arrange them in their proper relationships, one to another. It's the same with a house. What rooms have we got to have? Where is the sun, the prevailing breeze in summer, the view if any; where are the large shade trees?

A house plan starts with an embryo, which is purely diagrammatic. It might consist of a lot of rough circles, representing the first-floor rooms—no sizes, no rectangularity, no walls, just blobs of space. Crude connecting links might indicate which of these spaces must adjoin—kitchen and dining space, lavatory and front hall, for example.

Next, an architect would sketch out the site with street and boundary lines, put down an arrow pointing north, another sign indicating the prevailing breezes, another the view. Then he would reassemble his room areas so that the dining space got the morning

sun, the living room lined up for midday sun, the porch found afternoon shade and the breeze, with kitchen and garage completing the circle.

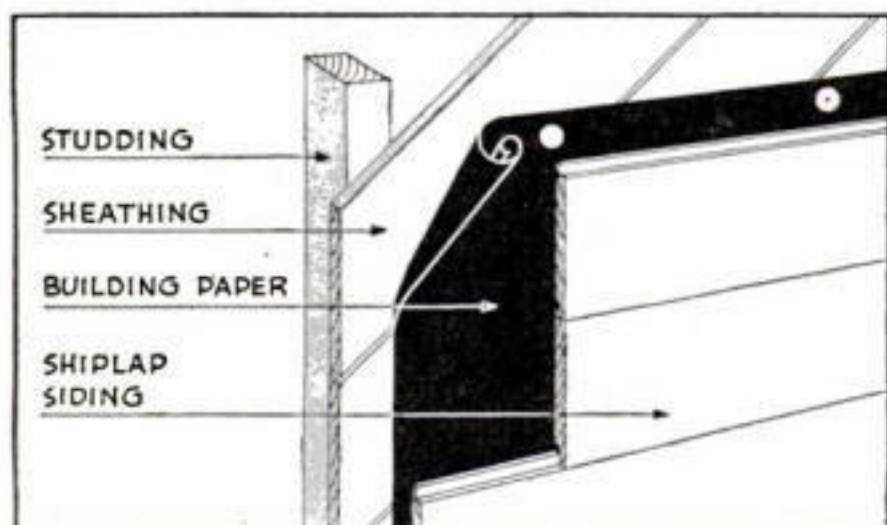
Having satisfied himself as to the proper orientation of the rooms, the architect would move on into what we might call the rectangular stage of his studies. On a piece of tracing paper he translates his blobs of first-floor space into adjoining rectangles. Perhaps he wants a living room in about the proportion of the "golden section"—a rectangle thought by many wise men of the past to give the most universally pleasing relationship between length and breadth. The accompanying sketch shows how it is done. On a square, one side of which represents the width desired, swing the length of the diagonal over and complete the rectangle at this new length. The ratio, of course, is as one is to the square root of two. However, the architect at this stage usually isn't thinking of such precise relationships. He sketches a rectangle, hooks on to it another for the dining room, one for the kitchen, the garage and other first-floor units. The result probably looks very unlike the neat rectangle or L-shaped mass he will eventually work out of it.



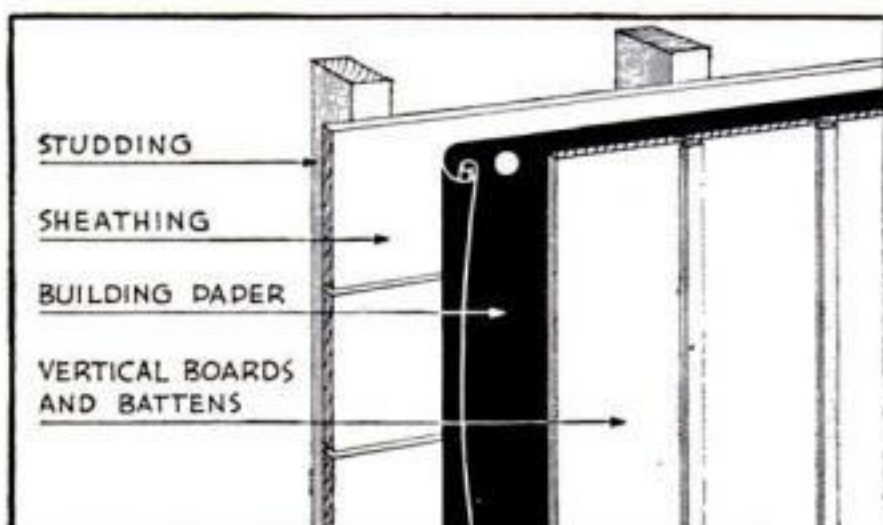
"GOLDEN SECTION"
RECTANGLE
DIAGONAL OF SQUARE
EQUALS LENGTH OF
LONG SIDE OF
RECTANGLE

Draw a square and use its diagonal to find the right length

3 Sometimes, where wood siding is required, the architect wants neither the horizontal lines of clapboards nor the vertical appearance gained with boards and battens. He then may specify shiplap, which gives a house a characteristic smooth-surfaced effect. Shiplap is occasionally used to advantage on the walls of the second floor of a house to break the monotony of horizontal siding or shingles



4 Siding isn't always used horizontally. It may be applied vertically with narrow wood battens over the joints, perhaps to lend an appearance of height to a house. This is the reverse effect of using horizontal siding, which tends to make a house look longer and lower than it really is. Boards and battens are frequently used for the second-floor walls with either brick or stone below for the first floor

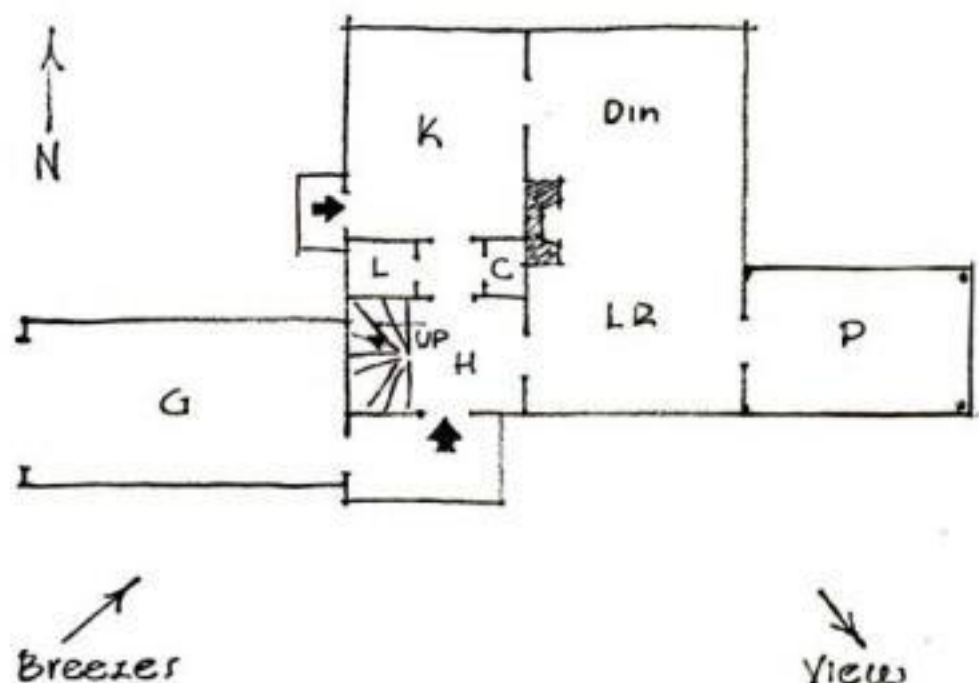


Down goes another piece of tracing paper right over the first, but kept loose so that he can roughly trace one room rectangle after another, changing entrance hall, putting in a closet here, turning the stair space sideways. Perhaps the jig-saw puzzle suddenly clicks together and for the first time looks like a house.

"What do you mean, 'looks like a house?'" It's only a diagram on paper."

Nevertheless the architect is visualizing the third dimension. It looks like a house to him because he sees how it can be roofed, where his ridge and gables come, how the width of the "L" will look in relation to its height—not too thin, not too squat.

However, if the architect is an old hand at this business, he will mistrust that sudden click; it came too easily. Back he goes over his room relationships, to see whether his kitchen is the right shape for fewest steps, whether windows and doors are going to rob him of the necessary wall space for cabinets, sink, refrigerator, range. Has he provided a coat closet near the front entrance? How does he get to the cellar? Can the owner get from his garage into the house with-



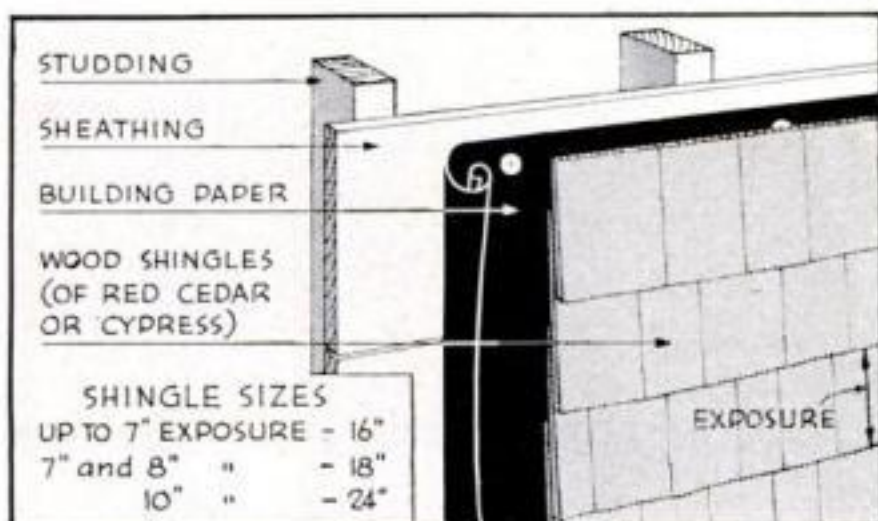
The second stage is to convert the first rough blobs of space into rectangles so as to form a coherent floor plan

out going through kitchen or dining room?

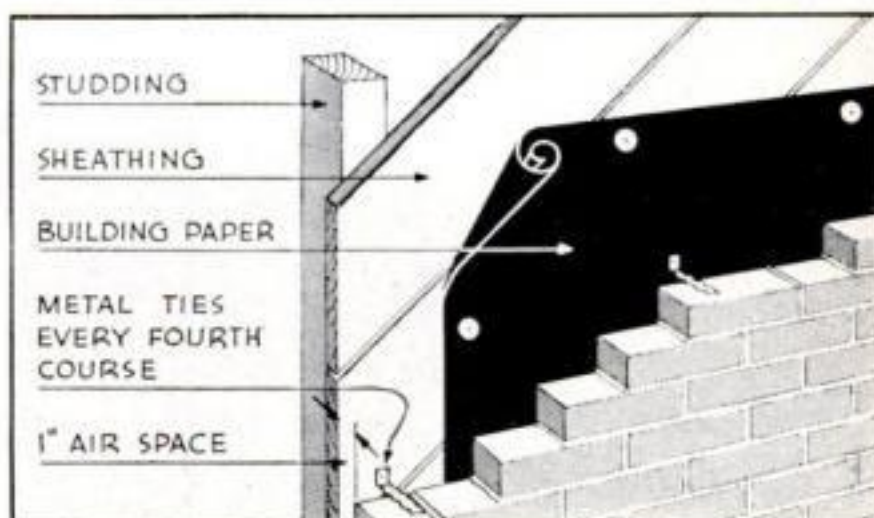
And not a single thought as yet about the second story? Yes, there has been an almost subconscious picture in the architect's mind as to what was going on upstairs. His stairway location had a lot to do with it; you can't have a stair that lands you out in a wing; it must arrive pretty much in the center of things if you aren't going to have a lot of hall running around up there.

But with the first floor looking rather promising, the architect thumb-tacks down another fresh piece of tracing

5 From earliest pre-Revolutionary times, wood shingles have been extensively used for siding as well as for roofing. Their durability is well attested by the fact that some of the oldest remaining Colonial houses still wear their original coat of shingles. Shingles can be painted or stained, or, if the wood is of suitable type and quality, simply left to weather unpainted to a soft silver gray



6 Not many materials can equal brick for durability, sturdiness, and ease and speed of erection. Brick requires no painting, but may be painted or whitewashed. Unlike wood siding, which is secured directly to the sheathing, brick veneer requires a 1" air space between it and the building paper. Metal ties nailed to the sheathing at every fourth course and 16" on centers hold the brick veneer to the frame



paper and, seeing his first-floor layout through this, he locates the top of the stairway and looks again at his sunlight and breezes and view. The owner's bedroom should be over in this general direction, the children's room nearby, perhaps with bath between. That brings the plumbing nearly over the lavatory below, and the one stack will serve both.

And so it goes, feeling tentatively for the right solution, seeking main relationships, proper "circulation"—which means getting from where you are to where you want to be, without too many steps and without going through other rooms, if possible. He is thinking of cross ventilation of bedrooms, of the need for wide and shallow clothespole closets.

Here I've carried you along to a point where the floor plans are ready for dimensioning, for the location of windows, doors, lights, heat outlets, and all the rest, and yet I've not even hinted at several other lines of thought that were in the architect's mind almost from the beginning.

One of these was *materials*. After the rooms began to fit together in rectangular form, a line on paper meant "wall" to the architect, and more than wall; it meant brick or wood or stone, according to which of these materials constituted the logical and economical choice for that particular locality. Or, the client may have specified at the outset that the house must be of brick. And as the plan began to approach its final pattern, the architect was think-

ing also of *sizes*: Living room, say 15' 4" wide. Why that odd 4"? Why not just 15' or 15' 6"? The reason is that the architect is thinking of joist lengths. They come cut to lengths in even numbers of feet. Allowing 4" at each end for a firm bearing, the plastered walls over a 16' joist span would be 15' 4" apart.

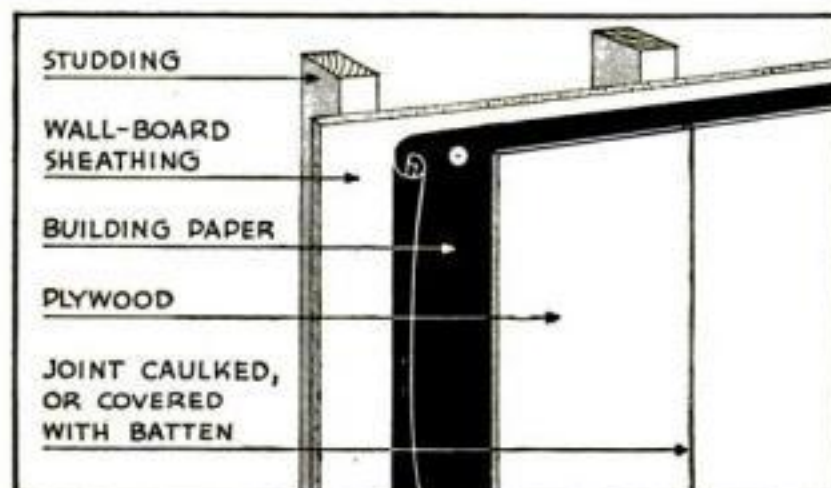
Or, in establishing his story heights, he knows that waste cutting of the studs is avoided if his first story of a wood-frame house is 8' 3" instead of an arbitrary 8' 6".

Again, when putting in doors and windows, he is thinking in terms of stock sizes. A wood sash will be 4" wider than the sum of the pane widths, and these are cut in stock sizes. A regular plastered partition is nominally 6" thick, but for short lengths we can turn the studs sideways and reduce the thickness to 4".

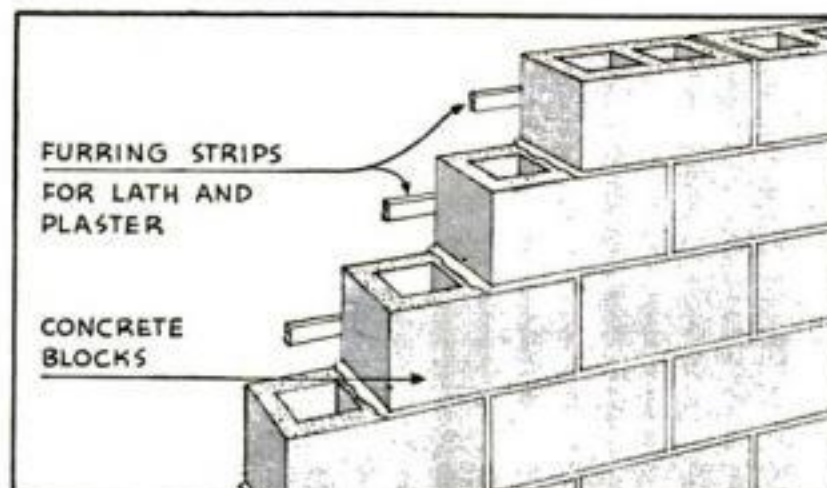
Perhaps many people think of an architect's job as sketching an attractive picture of a house and then dividing up the inside. That is putting the cart before the horse. The plan is the thing.

His job is not finished even when he has developed plans, elevations, and probably a vertical section or two. There remains the necessity of making clear to the builder just how and of what materials the whole assembly is to be constructed; where the heat ducts go; the hidden sinews of the house in pipes and wires; the quality of plaster and masonry; the sizes of joists, beams, rafters; even the quality of the paper that covers siding and roof boards.

7 Today plywood for exterior siding is coming into more common use because of its strength, durability, and economy of application. Special outdoor plywood is made for this purpose. While other standard sizes are available, the size generally used is 4' by 8'. It can be applied horizontally or vertically, and the joints between sheets are either caulked or covered neatly with wood battens



8 Concrete or cinder concrete block is another economical and durable material for walls. It can be erected very rapidly because of the convenient size of the blocks. These can be laid in regular courses, as shown, or in random sizes and courses to give the appearance of irregularly cut stone walls. When whitewashed or painted with a cement paint, the blocks present a neat, satisfactory appearance



Rules

THE object of this competition is to encourage readers to plan a house that will best fit their own needs and income, and be suitable for economical construction in their own locality.

Each entry should consist of: (1) Floor plans or sketches showing the layout and dimensions of the rooms. (2) A sketch or other representation of at least the front view or elevation of the house; and also one or more of the other elevations, if desired. (3) A brief description of the house and the materials of which it is to be constructed, including sufficient information about the finishing and equipment so that the judges can visualize it clearly. (4) A statement as to the size of the family and the income group for which the house is intended. (5) A statement that the design is original.

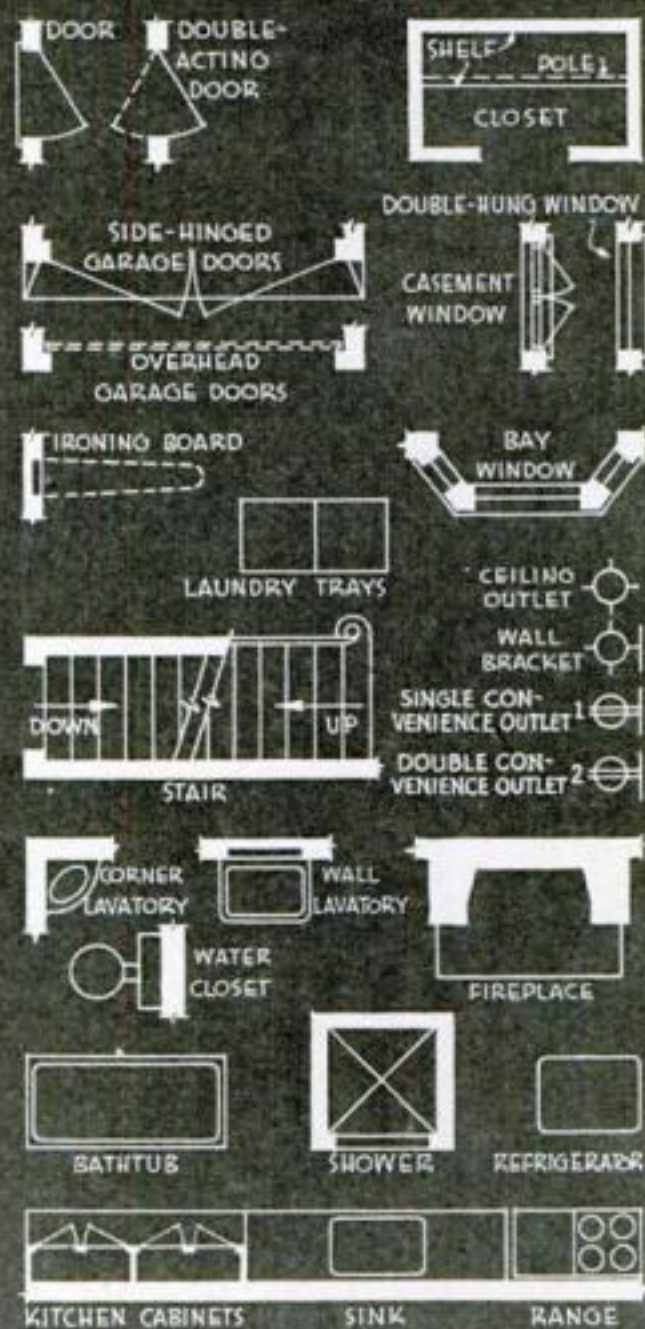
The drawings should be on good quality paper so as to withstand handling, and may be either in ink or pencil. The accompanying description should be typewritten if possible.

Only one entry can be made by each person, and no entries will be returned. The prize-winning designs will become the property of this magazine to be used in any way desired.

The competition will be judged by a committee of architects and editors of POPULAR SCIENCE MONTHLY. The decision of the judges will be final. In case of ties, duplicate prizes will be awarded to the tying contestants. The contest is open to all except professional architects and employees of Popular Science Publishing Co., Inc., and their families.

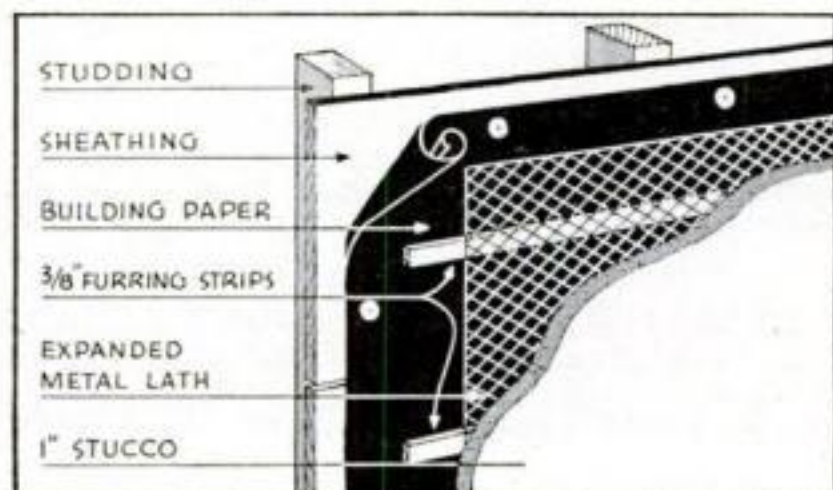
The contest closes April 15, 1941, and entries must be mailed fully prepaid and in an envelope or flat package (not rolled) on or before that date. Address the House Planning Contest Editor, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York, N. Y.

ARCHITECTS' AND BUILDERS' SHORTHAND

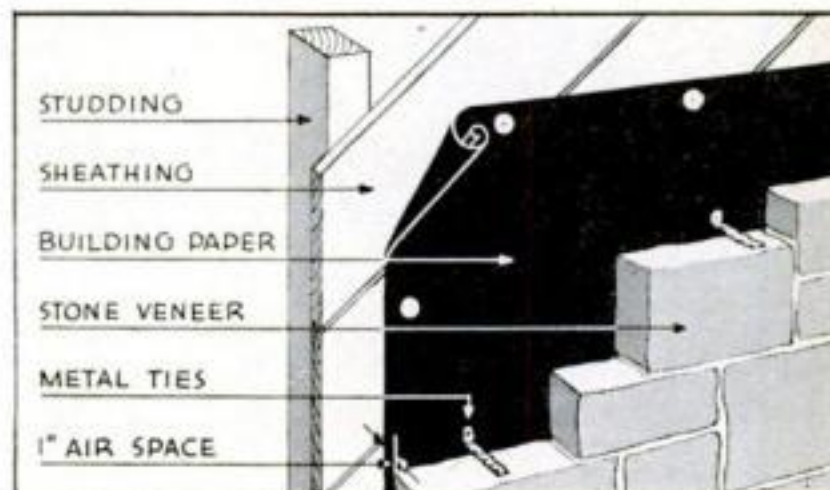


In preparing your plans for the contest, you will find it convenient to use these symbols, which are simple to draw and easy to read

9 Portland cement stucco is applied over metal lath secured to $\frac{3}{8}$ " furring strips nailed horizontally to the sheathing, except that when self-furring lath is used no furring strips are required. Stucco is usually applied in three coats. It lends itself to a variety of textures and finishes, and it may be colored by adding mineral oxide to the final coat. If relatively smooth, it may be painted



10 Stone veneer is another decorative and highly satisfactory material for walls, if properly used. It is secured to the wall in the same way as brick, except that for stone the metal ties should be placed every 16" vertically and every 24" horizontally. Stone veneer may be of ashlar, which is stone cut and squared, or of rubble, which is merely the name for stone as it comes from quarry or field



IDEAS *for* HOME OWNERS

ADJUSTABLE SOCKET WRENCH. Any size hexagonal or square nut can be gripped by this socket wrench, recently placed on the market. It has movable two-piece double-sided jaws, and adjustment is made by turning the serrated handle. A heavy duty screwdriver bit supplied with the tool fits between the jaws. Also provided is a small metal knob to slip over one side of the jaws and, when clamped in place, serve as a hammer for light work.



LEAKPROOF BATTERIES. When batteries are used for a long time at a stretch, they sometimes "flow over," that is, the chemicals break through the cells' walls. A special armor plating now applied to a new battery prevents this unpleasantness and the possible ruin of the flash-light case, because the chemicals are securely sealed within their shell. The manufacturer guarantees this protective condition for the life of the battery.

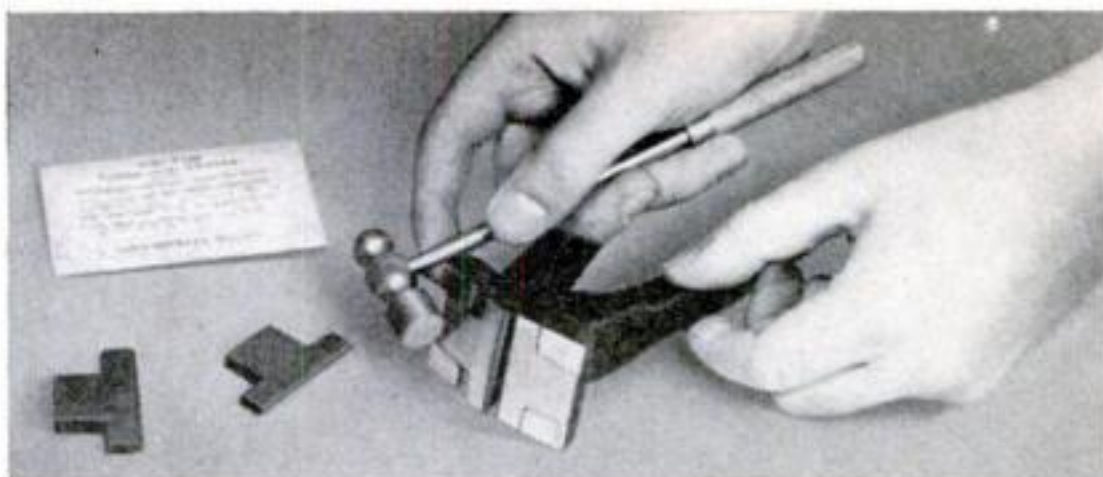


WINDOW GREENHOUSE. Every lover of flowers and plants can now have a miniature greenhouse attached to his home. Although made in only one size, it fits around the average window, a special caulking compound sealing it to the house when bolted in place. No cutting, fitting, flashing, or extra construction work is required. The greenhouse has a steel frame protected against rust by metallic paint and is also coated with greenhouse white paint, which forms the priming base for a finish coat to match the house. Ventilation in the winter is supplied by ventilators in the top of the side panels. The overhead panes catch added heat from the sun. In the summer several glass panels are replaced with screens.

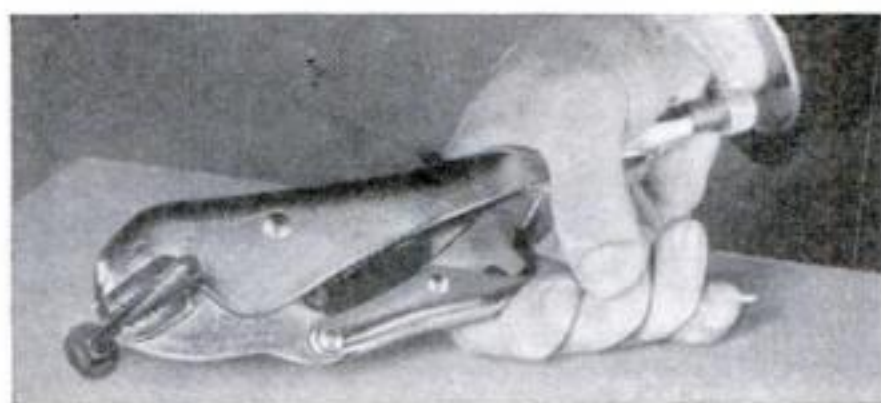
PORTABLE FENCE FOR DOGS. If your wire-haired terrier, or similar small dog, gets the wanderlust feeling, a portable metal fence provides the means of keeping him at home. It is easily carried out to the lawn and set up so the dog can frolic about. The fence comes in six or eight panels and is high enough to discourage jumping.

CUTTER HAS REPLACEABLE JAWS.

Long life is assured for this cutter because new jaws are easily inserted when the original ones become too dull. A set screw in the handle regulates the edge of the jaws. To replace the old cutters, the tool is opened wide and the cutters driven out with a hammer, then the new ones are wedged in place. The nippers are available in four sizes—7", 8", 10", and 12".



Tapping new cutters in place after pulling out the worn jaws



WRENCH GIVES TON GRIP. Claimed to be the most powerful hand tool ever built, a new wrench has double-lever action that enables the grip of one hand to exert more than a ton pressure on the work. The jaws remain locked but can be instantly released. The tool can be adjusted for ratchet action.

TOGGLE-BOLT CLAMP SAVES TIME. The old laborious method of having to pull out on a toggle bolt to prevent it from turning while being tightened is eliminated with a new clamp now available. It holds the toggle tight against the inside of the wall, and permits the mechanic to use a screw driver instead of having to hold the bolt out with his fingers. To use, install the bolt in the regular way. When the bolt is ready to be tightened, pull the toggle tight against the inside of the wall, slip the clamp over the bolt thread flush against the bracket or fixture to be anchored, and tighten the bolt with a screw driver. Then remove the clamp and give the bolt one more turn. Installation time is cut nearly 50 percent.



Built on a continuous foundation, these houses sell for \$7,495

NEW ROW-HOUSE CONSTRUCTION.

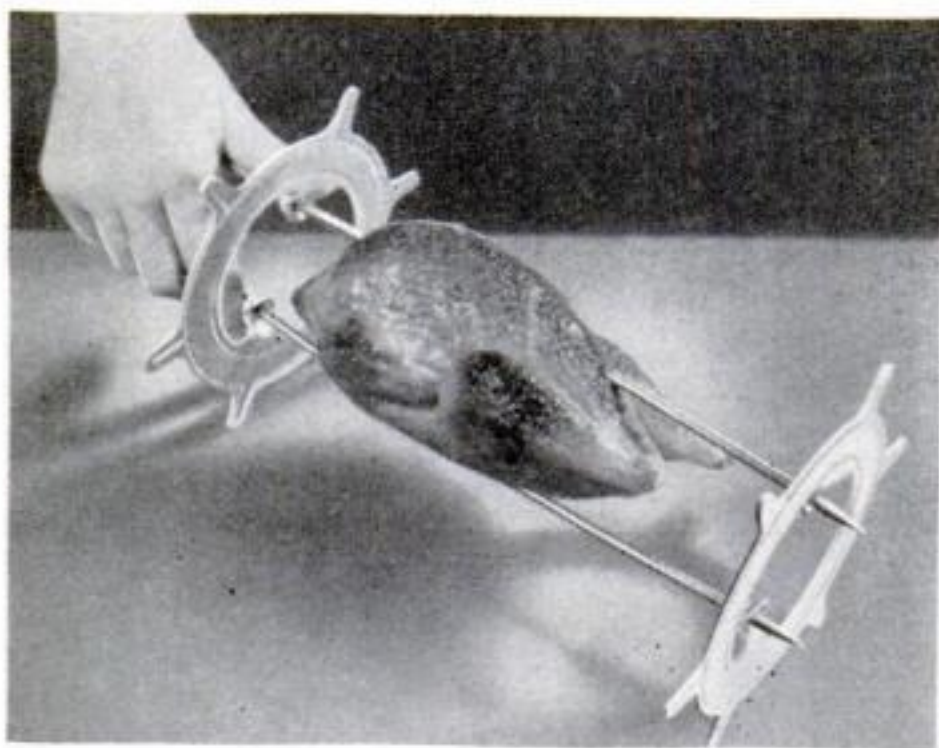
By digging out one large cellar the length of a city block and placing the houses 9' apart on top of the ground, Lind & Luckman, Inc., Chicago architects, have solved the problem of how to use money-saving row-house construction methods for single-family homes without the disadvantage of identical walls and exteriors. Basic trick of the plan is to dig a long trench 3' deep and throw the excavated earth out in front to provide a terrace 3½' high. Then continuous front and back foundations are poured and cross walls built of concrete blocks. Next step is to erect the houses in pairs, each pair with a basement party wall. The projecting basement room is for laundry and storage, thus leaving most of the basement within the house walls for a big recreation room. The concrete laundry roof makes a sidewalk and service court.



New Appliances

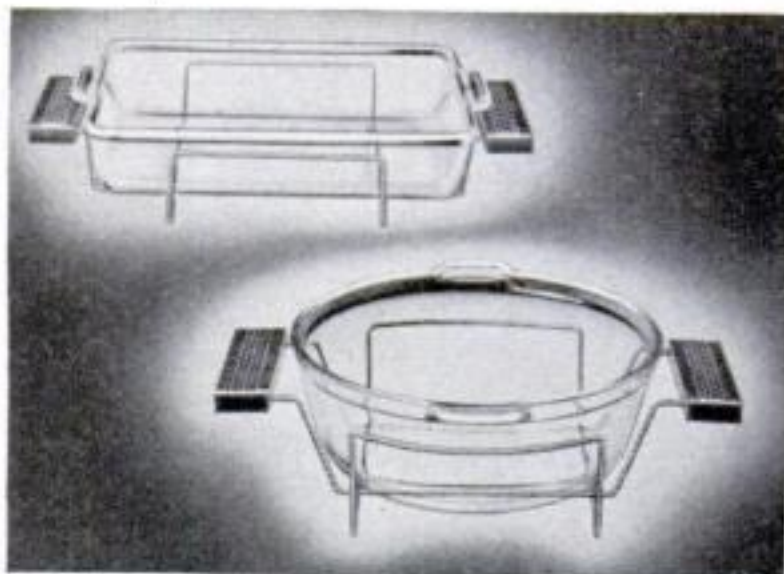


LONG TELEPHONE CONVERSATIONS become a pleasure when a comfortable place to sit is available; and this bench solves the problem. It is 34" long, 19" wide, and 30" high. Note directory shelf under the seat



ROAST SUPPORT. Meat is easily turned for even roasting on all sides when suspended on a new device which consists of a long fork and two "ship's-wheel" supports

OVENWARE HOLDERS. Nickel-plated metal frames with oak handles allow oven dishes to be placed on a table without the use of hot pads



RUSTPROOF METAL TABS laid on home jelly before covering with paraffin, as below, aid in removing wax. Tabs attach to metal covers



PAPER PIE PLATES now available are said to absorb excess grease and moisture, and yield a light crust. Metal rims reinforce the plates

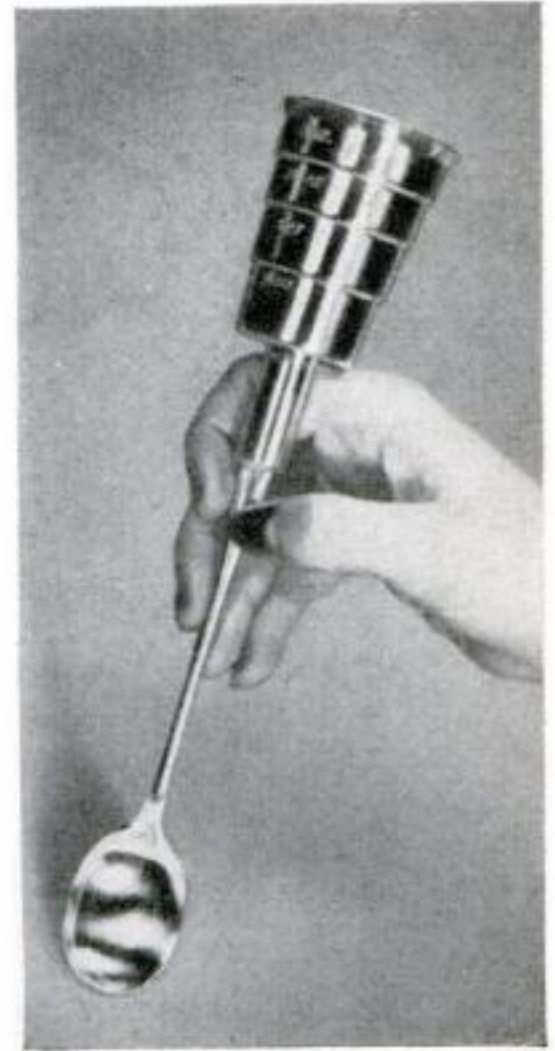


for the Household

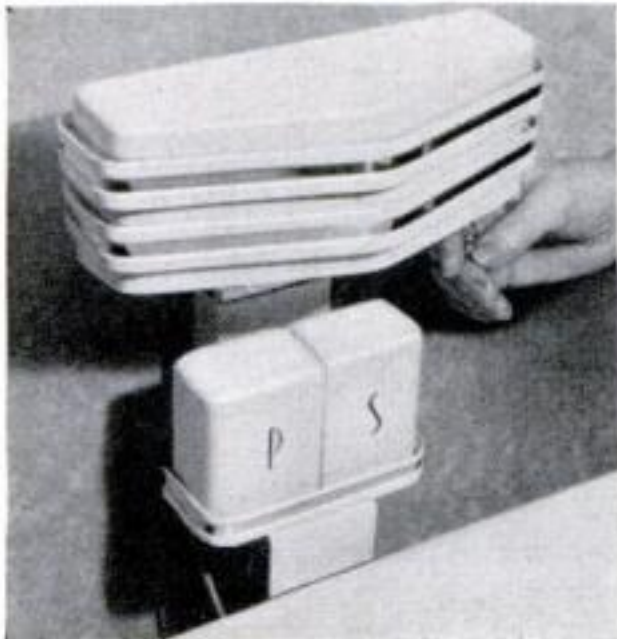
TRIPLE-PURPOSE MIRROR can be used as a wall mirror, below; coffee-table top, at right; or as a serving tray. The hand-holds are recessed. Mirror is 16" by 26"



DRINK - MIXING AID. Beverages are compounded accurately with the combined measuring cup and spoon at right. Liquid flows from bottom of cup if top is pressed



STOVE LIGHT. Placed over the range, this lamp and condiment set gives a modern touch to any kitchen



ELECTRIC CALENDAR CLOCK shown below tells time of day, day of week, and date of month



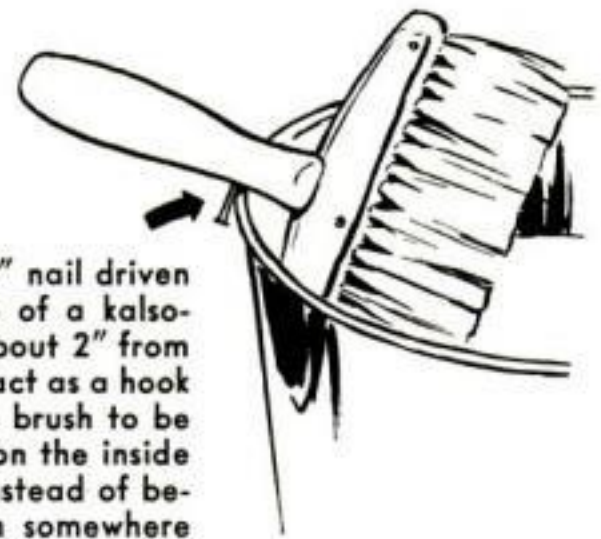
KEEPING THE



Cut sheets of tin foil to fit under the flowerpot doilies; then dampness will not reach the polished surfaces of your furniture. These inexpensive protectors may be cut in circular form or scalloped to conform with the general outline of the doilies



Handles of old dish mops, scouring brushes, and other kitchen tools can be put to many uses, so it pays to make a practice of tossing worn-out brushes into the scrap box. Plugs for floor holes can be obtained from a tapered handle. The knob on a second handle may serve as a drawer pull. Perhaps a third handle can be transferred to the tang of a file. If the bristles are pulled from a curved brush, a rounded sanding block is gained



An ordinary 2" nail driven in the handle of a kalsomine brush about 2" from the head will act as a hook and allow the brush to be hung quickly on the inside of a bucket instead of being laid down somewhere



Your chamois skin for washing windows will be improved if a piece of flour or sugar sack, or some muslin, is sewed to the back. Wash the windows with the cloth side and polish with the chamois

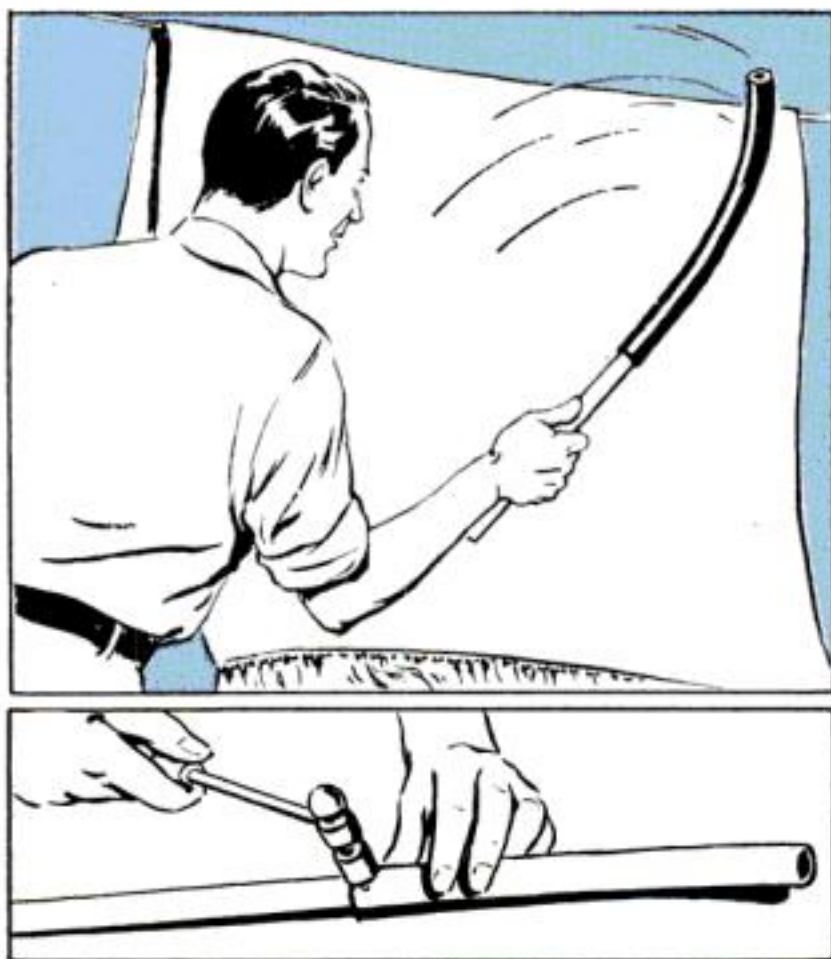


Towels often slip off the smooth bars of a rack, but this can be prevented simply by winding a narrow strip of rubber splicing tape around each rod at two or more points

HOME SHIPSHAPE



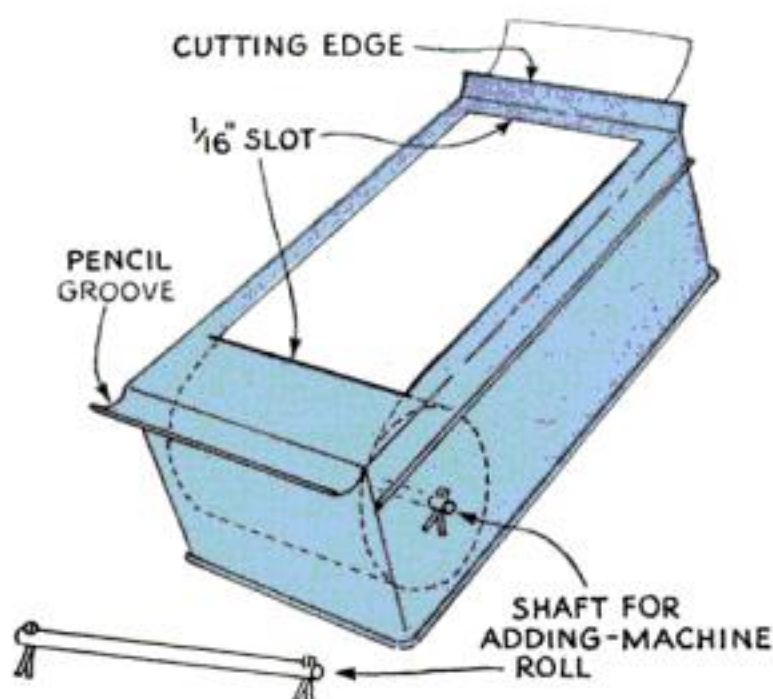
If in doubt about a garment's color fastness, wrap it in waxed paper after sprinkling and it cannot stain other pieces in the ironing basket



Spring cleaning days will soon arrive and that means knocking winter's dirt from all the rugs. You can make a serviceable rug beater by tacking a piece of garden hose to a short length of an old broomstick



Do some of your kitchen tools need oiling? Try applying a little glycerin by means of an eye dropper. The glycerin will not cause a bad taste in the food if any should drop in



A rectangular tin, such as those used for holding candy or nuts, can be converted into a handy shopping memo. A convenient size is $3\frac{1}{2}$ " by $3\frac{1}{2}$ " by 6". Cut two slots in the top just wide enough to accommodate adding-machine paper. Flatten each end, bending one up for a cutting edge and curving the other to hold a pencil. Punch holes for the axle, which can be a dowel with cotter pins. Paper rolls can be obtained at a stationery store



Cleaning bed springs has always been a problem for the housewife. The problem is easily solved, however, by using an old dish mop, which is twisted in and out of the springs



To keep a bathtub or lavatory stopper on its chain, loop the chain through the ring. The loop relieves the little fastener of strain that causes it to work off the ring



Outlines are marked on the stones with a pointed strip of aluminum



The cabochon blank is roughly ground on a silicon-carbide wheel



Below, small imperfections are removed by sanding on a disk covered with silicon carbide



The roughly ground stones are warmed over an alcohol lamp and cemented to short dowels



Heart-Shaped Jewelry

By W. T. BAXTER

Art Metal and Jewelry Instructor,
Woodrow Wilson High School,
Washington, D. C.

BY USING a grinding or buffing head with a step pulley for various speeds, you can grind and polish beautiful heart-shaped cabochons or smoothly polished stones from semiprecious gem material. When mounted, these make attractive pieces of jewelry.

Suitable pieces of agate, petrified wood, or other stones can sometimes be found locally and are always obtainable from dealers at moderate cost. Larger pieces can be sawed into convenient blanks with a diamond-charged disk or by using a disk running in No. 100 grit silicon carbide and water*.

Study the material to be ground and mark the outline with a pointed piece of aluminum on the least attractive side, which will be the bottom. Use a paper pattern or a cut stone as a pattern. Grind the stone to shape on

*How to saw mineral specimens was described by Mr. Baxter in a previous article (P.S.M., Oct. '40, p. 174).

Left, the disks are prepared by brushing on a coat of glue and pouring on the silicon carbide



a No. 100 grit silicon-carbide wheel, running at a speed of approximately 5,000 surface feet per minute.

Next, warm the roughly ground stone and cement it to a short length of dowel rod (called the "dop stick") with lapidary cement, a mixture of sealing wax and flake shellac, or a mixture of pitch and clay flour or whiting.

Hold the stick in the hand and continue the grinding on a No. 220 grit silicon-carbide wheel. It is essential to have the stone in constant motion. Keep the stone cool and the wheel clean by spraying water on the wheel, or else run the wheel in a trough with its lower part in the water.

Remove imperfections left in the grinding by sanding the cabochon on a revolving resilient disk made as shown at the end of this article and coated with No. 220 silicon-carbide grit. Cement the grit in place with either glue or silicate of soda (water glass), which is obtainable at drug stores. Use no water in this operation. The notch in the top of the heart can be sanded by hand with silicon-carbide cloth wrapped around a stick.

The final luster is obtained by polishing on a felt or muslin wheel. Tin oxide or rouge powder mixed with water is used in this operation. Sanding and polishing do not require the high speed necessary for grinding.

Mountings for the jewelry should be made from sterling silver. For finger rings use 18- or 20-gauge (B. & S.) sheet silver or 16-gauge round wire. Prepare a paper pattern for the sheet silver rings, cement to the silver, and saw out with a No. 2/0 jeweler's saw blade. Bend to shape, adjust for size, and silver solder the ends together.

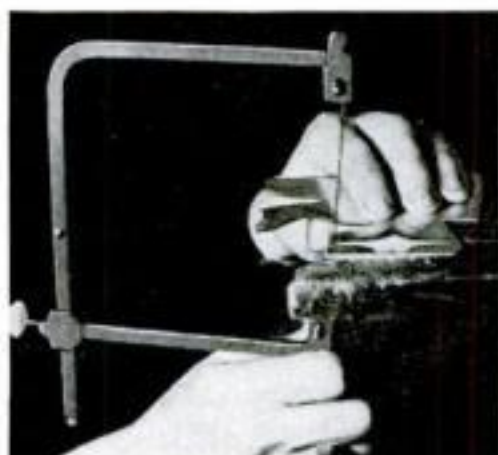
Make the bezel for the stone from 26- or 28-gauge sterling or fine (pure) silver. The bezel



The notch in the heart is shaped with silicon-carbide cloth wrapped around a stick



The cabochon is next polished on a hard felt wheel by the use of tin oxide mixed with water



Section of bezel showing the two parts. Left, a jeweler's saw is used to cut ring blanks



Silver-soldering a decoration on a ring formed from sheet silver

Below, a burnisher is used to bend the bezel down over the stone



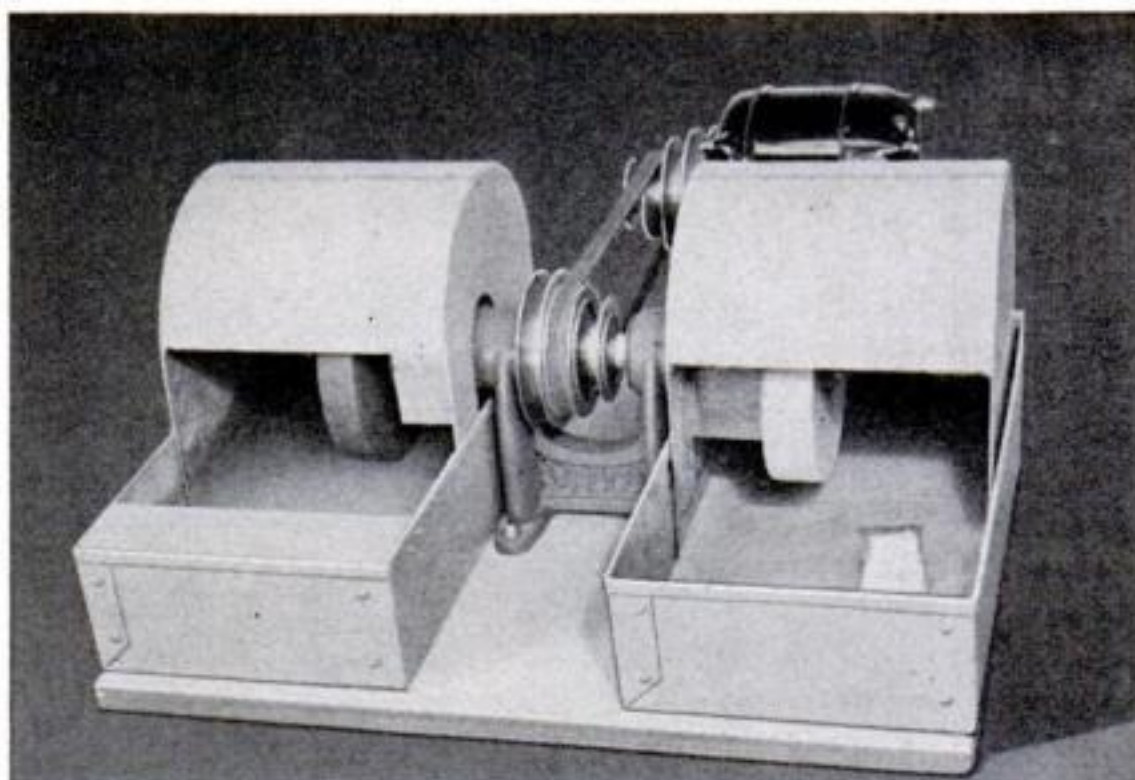
should be of such a size that the stone will just slip into it. Cut a bearing or support for the stone from thicker silver or wire to keep the stone from slipping through the bezel. Solder the two together.

Silver solder for this purpose may be obtained from jewelry supply houses. Use borax mixed with water as a flux. Remove the glazed borax and oxides left from soldering by pickling in a solution of one part sulphuric acid and ten parts water. CAUTION: Add the acid to the water slowly and carefully. Heat the solution in a copper pan and remove the jewelry with copper tongs. Use files and crocus cloth to smooth the assembled piece. Polish on a muslin buff with jeweler's rouge.

Set the stone by forcing the bezel over the edges of the stone with a burnisher or other smooth object. Polish again to remove burnisher marks, but keep the buff off the stone.

Silver soldering, which is often called hard soldering, is not difficult to learn if you keep the following facts in mind: Silver solder flows at a temperature of from 1,400 to 1,550 deg. F., so the object must be heated red hot. Cover both solder and joint with flux. Make the joint tight fitting. Keep the flame off the joint itself as much as possible, and move the flame constantly to prevent overheating any one portion. Heat may be applied with a small gas blowpipe or a small blowtorch. Use a charcoal or asbestos block upon which to solder.

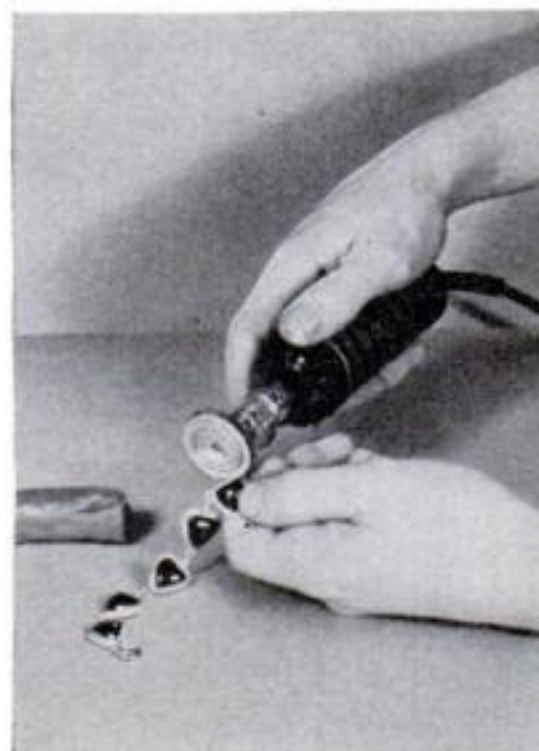
The methods described can be used to make a novel autograph book or small album. The cover and back are of sheet copper, and the decoration consists of a heart-shaped cabochon mounted on a silver heart. The bezel is silver-soldered to the heart, which is soft-soldered to the copper cover.



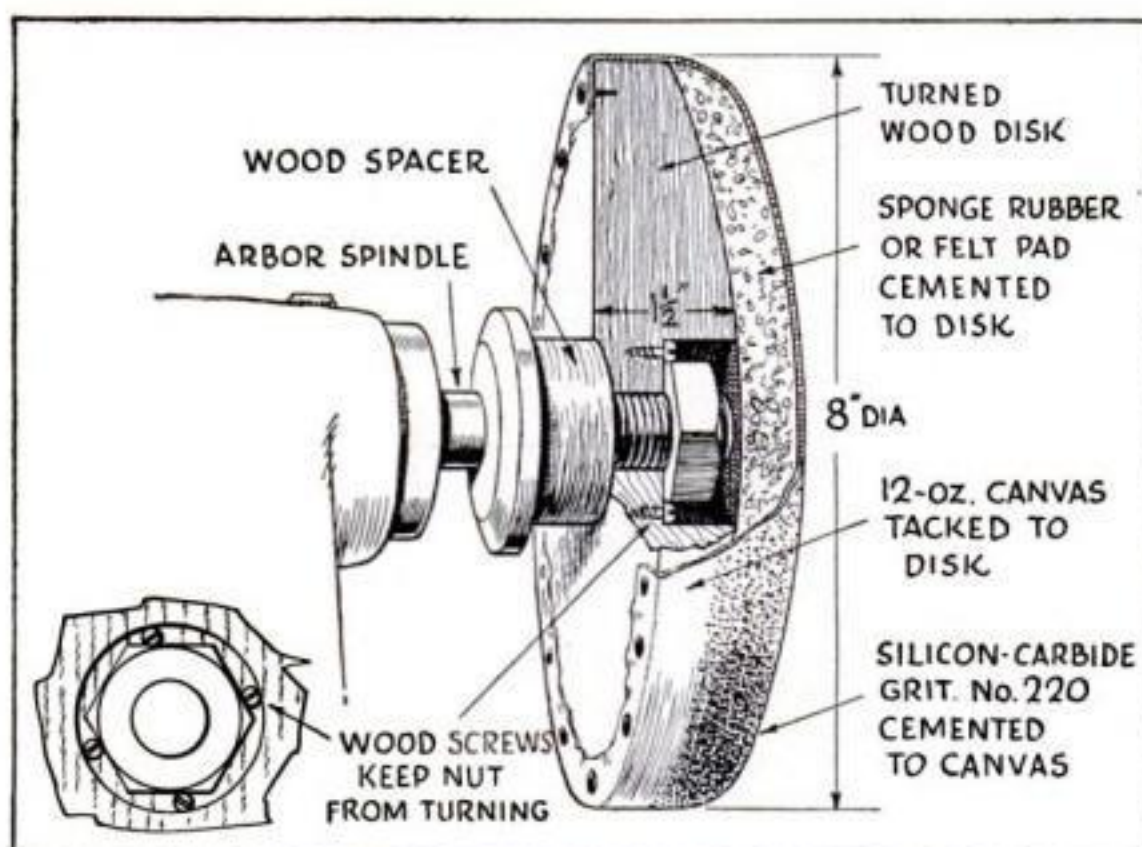
This is a typical high-grade lapidary outfit such as is used by amateurs for grinding, sanding, and polishing. It has four speeds



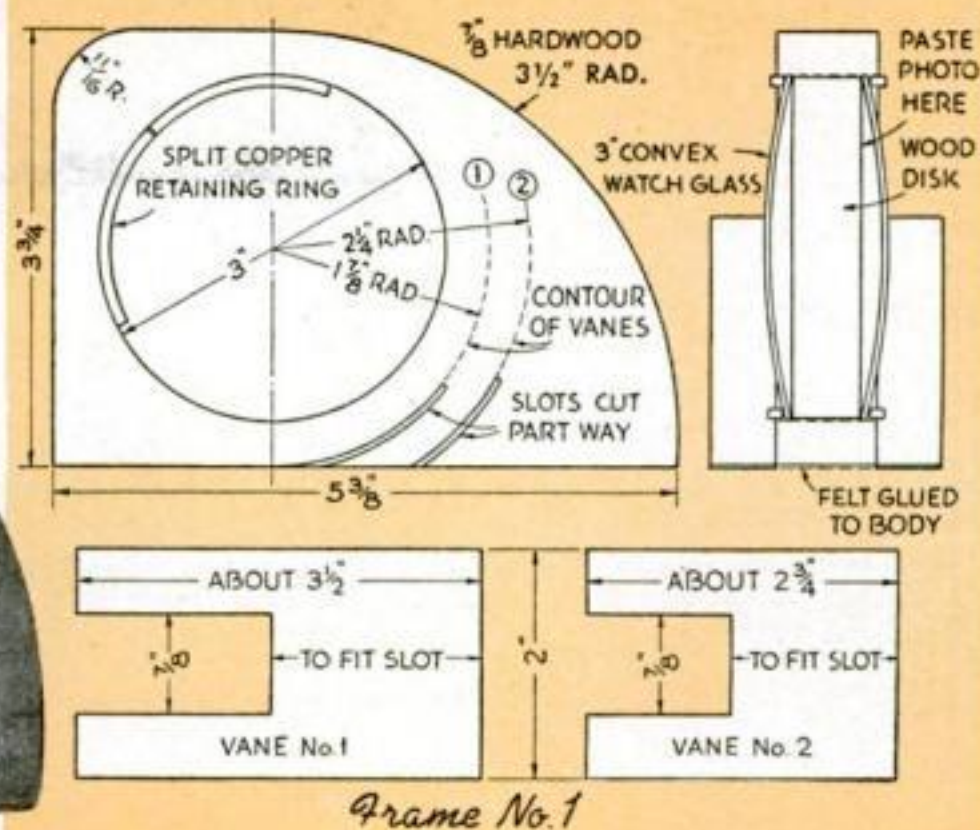
Glazed borax and oxides are removed by pickling the jewelry in a weak sulphuric-acid solution



Marks left by the burnisher are polished out with jeweler's rouge applied on a buff



WORKING TIME: One Evening



Reversible Miniature Photo Frames

By HARRY WALTON

Average construction time: First frame, 3 hr. Second frame, 3 1/2 hr. Third, 2 1/2 hr.

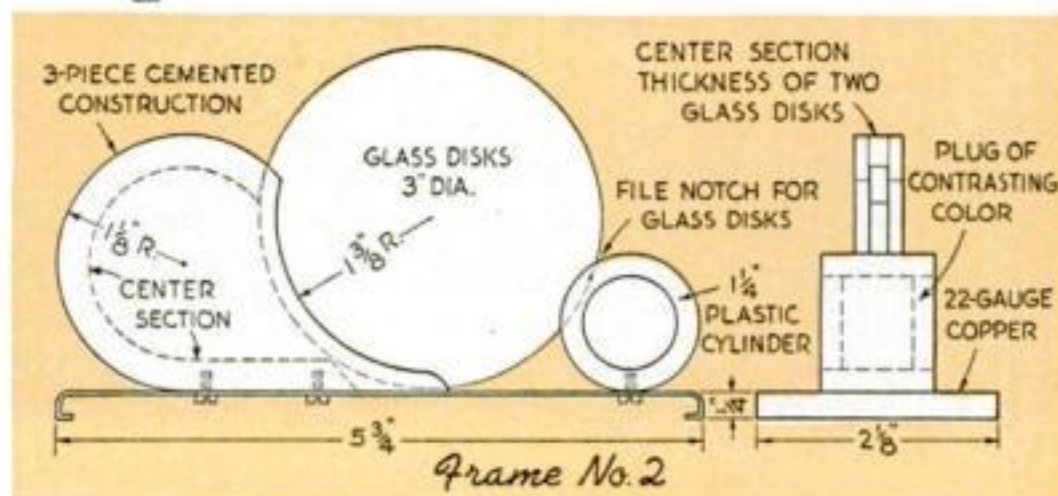
ASIDE from the time needed for cement to harden, any one of the three miniature frames illustrated on this and the following page can be made in an evening's time. The dimensions given can be scaled to any size if larger photos are to be used.

Maple contrasts with gleaming copper in the first frame. Lay it out completely before cutting the circular opening, the shoulders of which must be sharp and square. The concentric slots are cut only part way up, and are just wide enough to accommodate the metal used. The convex "watch" glasses, sold by chemical supply houses for a few cents apiece, are held in place by 1/8" wide copper rings, cut from a scrap piece of thick-walled seamless pipe, split, and filed to a press fit. The vanes are about 24-gauge copper (or aluminum if the body is of walnut or is to be stained dark). They are pressed into place without other fastening. The wood body is finished by any preferred method. A loosely fitting wood disk spaces photos and glasses.

If a still more modern effect

is desired, the body of frame No. 1 can be built up by cementing together pieces of sheet plastic instead of using hardwood.

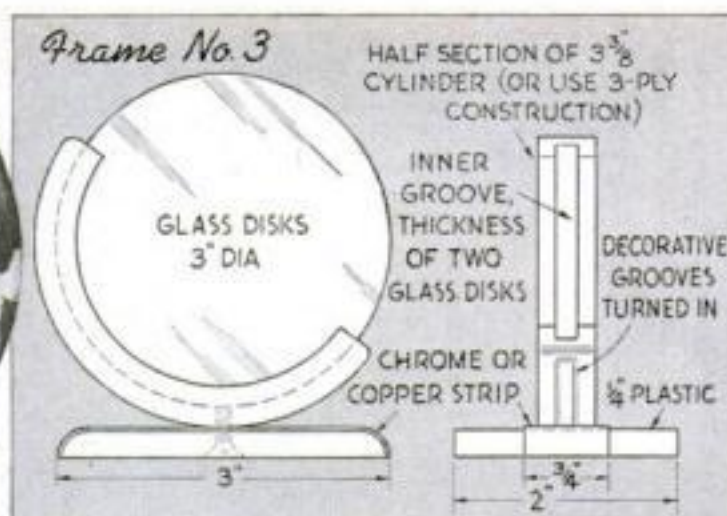
The larger element of the second frame is cemented up of three sections of sheet plastic, and two colors can be used. The piece in the center is slightly thicker than the two glass disks to be used. When the cement has set thoroughly (preferably under pressure), the edge is sanded to size



and polished. The smaller element is a piece of $1\frac{1}{4}$ " outside-diameter plastic tube plugged with two contrasting disks and having a notch filed into its circumference to take the glass disks. The latter may be flat flash-light replacement glasses (not lenses), which are available in many electrical and hardware stores in the

3" size at a few cents apiece. Four small machine screws are used for assembling the parts. The screws will cut their own threads in plastic if holes of the right size are first drilled.

The third frame is a half section of $3\frac{5}{8}$ " diameter plastic cylinder with the groove for the glass disks turned on a lathe or formed with a side-cutting head on a drill press or routing table. For large sizes, or if a suitable cylinder is not available, cement three semicircles together, the center one $\frac{3}{16}$ " narrower than the others to form the glass groove. Shallow ornamental grooves on the outer edge can be made by chamfering contiguous edges before cementing the pieces. The base may be a single piece or two pieces of harmonizing colors cemented together. A narrow strip of polished chrome or copper sandwiched between base and frame provides



The semicircle is cut from a cylinder, but could be built up from three pieces

the trim. Assemble with a single 8-32 screw.

Copper can be given a high polish by rubbing it with very fine steel wool or No. 400 abrasive paper and then buffing on a cloth wheel with fine abrasive compound. A pleasing brushed finish is obtained by passing the metal in one direction only against 2/0 emery cloth on a felt-backed sanding drum. To prevent discoloration, all metal should be given a coat of clear lacquer promptly after buffing or brushing. First, however, wash off all traces of dust or compound with soap and water.

The plastic material is finished by progressive use of 2/0 sandpaper, Nos. 360 and 600 grades abrasive paper (used wet), and a clean cloth wheel with buffing compound. Final high gloss is best obtained with a second clean wheel (kept for plastics only). It is used either dry or with extra fine compound.

ALUMINUM AND STEEL

[METAL ETCHING—4]

Aluminum is etched in the same manner as copper and brass, except that muriatic acid is used. Full-strength muriatic acid will etch to a depth of about 0.003" per minute, and slower in proportion to how much it is diluted with water. Dilution is often desirable in order to give better control of the operation.

Steel may be etched quickly and satisfactorily with one part muriatic acid and one part commercial nitric acid. This is much used for etching names and designs on tools. Clean the metal thoroughly with whiting or any suitable abrasive. Write or print the name on with asphaltum varnish, or coat all over with asphaltum and scratch the name in the asphaltum when dry. Then apply a few drops of the etching solution on the part to be etched, and let remain until etched deep enough.

Remove the asphaltum with kerosene or lacquer thinner. Clean the etched part thoroughly and coat well with oil to prevent rust.

POPULAR SCIENCE MONTHLY SHOP DATA FILE

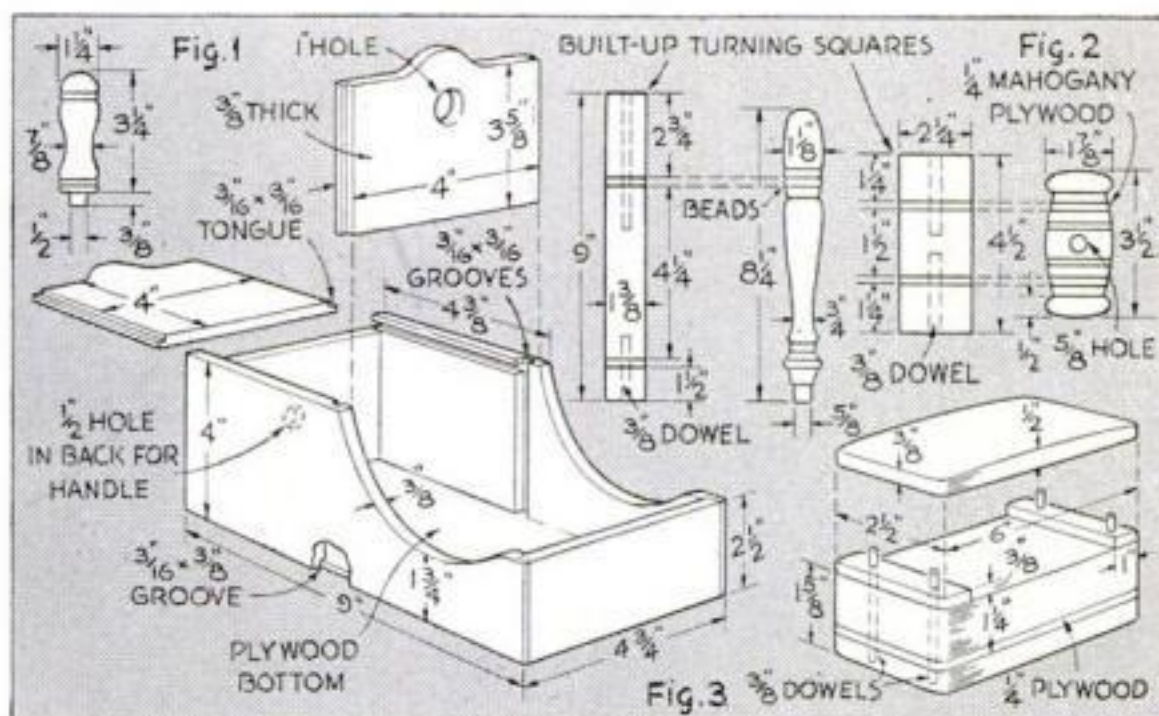
Gavel, Ballot Box, and Striker



The slanting hole for the marbles is bored in the panel of the ballot box by tilting the table of a drill press, if one is available. Waste stock is used as shown to hold the work securely for this operation



A light tap of the gavel on the striker gives out sound enough to fill a large hall. The ballot box can be seen at the right



CLUBS, lodges, and other organizations will welcome the gift of a gavel, striker, and ballot box like those illustrated. Home workshop clubs in particular will find the three pieces of great interest as there is no end of original designs that may be worked out so long as the basic measurements are followed. The cost of materials in this case amounted to \$1.50.

The sides, front, back, and handle of the ballot box (Fig. 1) are cut from $\frac{3}{8}$ " solid walnut. The pieces are grooved as shown for the sliding front panel and lid, which are cut from $\frac{3}{8}$ " walnut plywood. Cut grooves on the inside lower edge of box for the $\frac{3}{8}$ " plywood bottom. A ballot box of this size will accommodate at least 200 voting members if the marbles used are $\frac{1}{2}$ " or less in diameter.

The turning squares for the

handle and head of the gavel (Fig. 2) are made up of walnut and reinforced with $\frac{3}{8}$ " dowels. Mahogany plywood $\frac{1}{4}$ " thick and good on both sides is used for the inlays. Bore a $\frac{5}{8}$ " hole 1" deep in the turning square for the handle tenon before turning the head.

The lower section of the striker (Fig. 3) is glued previously to adding the top. Note that the top has a $\frac{1}{8}$ " crown from center to edge. As in the gavel, mahogany plywood is used for the inlay; the remainder is cut from solid stock. The advantage of this type of striker is that a light tap resounds through even a large hall.

It would be most practical to finish the striker with an oil rub, but the other pieces can be finished as preferred. Glue a suitable piece of soft felt to the bottom of the striker.—FRANK HEGEMEYER.



Average Time
6 hours



Low-Cost Modern Bed

DESIGNED BY J. W. HITE and DONALD A. PRICE

BESIDES being economical and easy to construct, this modern bed has a variety of advantages. It differs from those of similar type found in furniture stores in that the side cabinets are hinged so they will turn back. In that position they do not shut off the air and are not in the way of making the bed.

Back of the headboard is a storage place for card tables or other bulky objects that are not easy to store in a small apartment. The open ends of this compartment are closed when the side cabinets are swung back against the wall, but drapes may be hung in these openings, if desired. The cabinets have a tilting drawer or bin hinged at the bottom for storing extra blankets.

All dimensions given are for standard double-bed springs, but it is best to check these against the particular set you expect to use. The springs are shown as resting directly on the ledge formed by the top of the inside $5\frac{1}{2}$ " boards next to the floor. With some springs it may be necessary to support them by cross slats resting on this ledge, or the springs may be blocked up from the floor to the proper height.

Heights are suited to the wall units described in a previous issue (P.S.M., Dec. '40, p. 176). The bed cabinets are essentially the same as the No. 4 unit shown there.

Knotty pine, clear pine, and redwood are the most inexpensive to use. At 12 cents a board foot, the cost of the lumber and plywood would be about \$12. Birch and

maple are preferable structurally and can be more effectively finished if it is necessary to match other furniture. Figuring on hardwood at 20 cents, the cost of the stock would be about \$19. The additional expense for hardware, clips, angles, screws, and finishing materials should be between \$4 and \$5.

LIST OF MATERIALS—54" BED

No. Pc.	Description	T.	W.	L.
2	Sides, upper	$\frac{3}{4}$	$8\frac{1}{2}$	$76\frac{1}{2}$
2	Sides, lower	$\frac{3}{4}$	$5\frac{1}{2}$	76
1	Footboard, upper	$\frac{3}{4}$	$8\frac{1}{2}$	55
1	Footboard, lower	$\frac{3}{4}$	$5\frac{1}{2}$	$53\frac{1}{2}$
1	Headboard, main (May be glued up from solid stock or made from $\frac{3}{4}$ " plywood)	$\frac{3}{4}$	$24\frac{3}{4}$	$60\frac{1}{2}$
3	Headboard cleats	$\frac{3}{4}$	$3\frac{1}{2}$	23
1	Headboard top	$\frac{3}{4}$	$5\frac{1}{2}$	$60\frac{1}{2}$
1	Head shelf	$\frac{3}{4}$	$8\frac{1}{2}$	$60\frac{1}{2}$
2	Quarter-round mldg., ends	$\frac{3}{4}$	$\frac{3}{4}$	$55\frac{1}{2}$
2	Quarter-round mldg., sides	$\frac{3}{4}$	$\frac{3}{4}$	$77\frac{1}{2}$

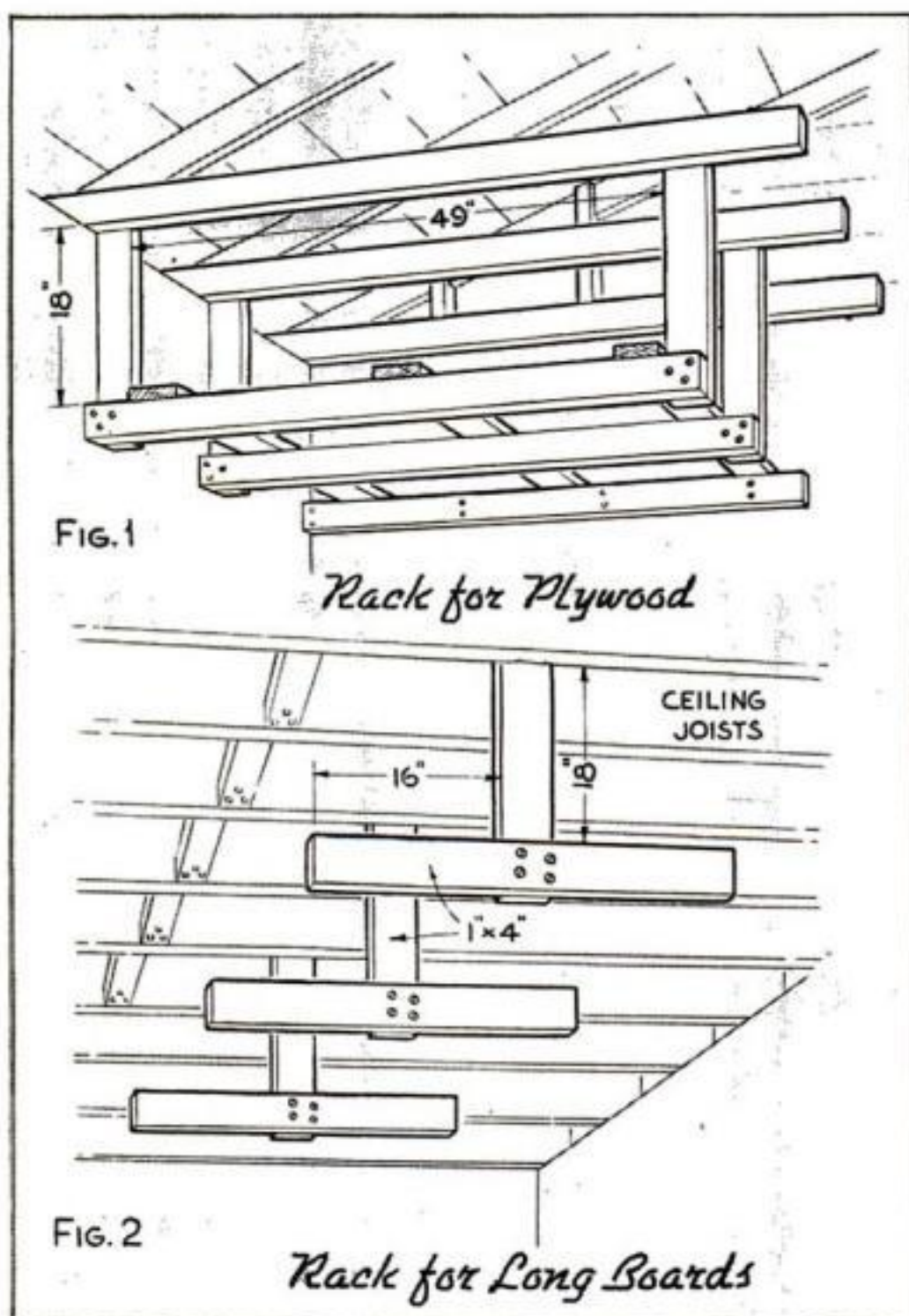
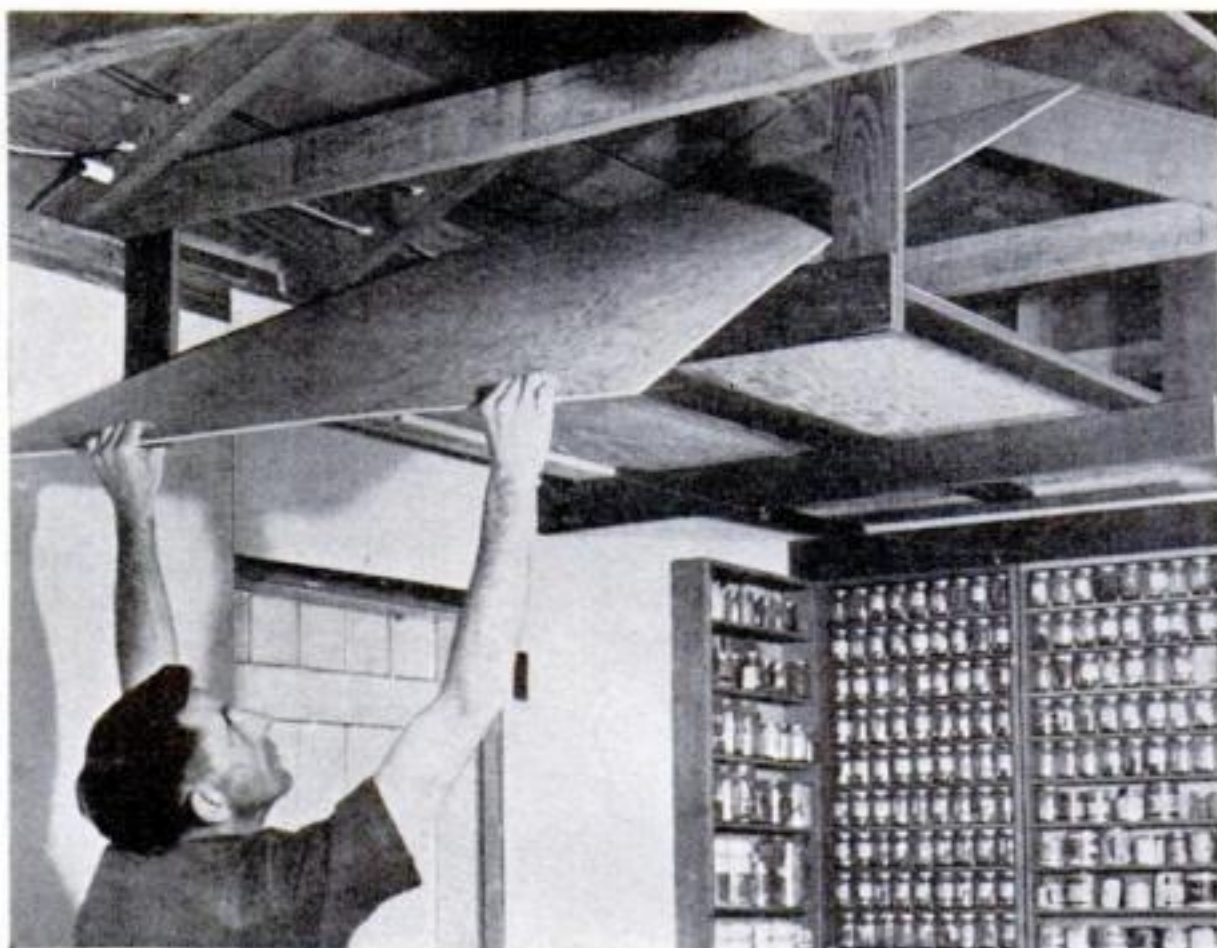
CABINET (QUANTITIES FOR ONE ONLY)

2	Ends	$\frac{3}{4}$	$11\frac{1}{2}$	33
2	Top and bottom	$\frac{3}{4}$	$11\frac{1}{2}$	24
1	Shelf	$\frac{3}{4}$	11	24
1	Back (plywood)	$\frac{1}{4}$	23	$33\frac{1}{2}$
2	Base, front and back	$\frac{3}{4}$	$3\frac{3}{4}$	20
2	Base, ends	$\frac{3}{4}$	$3\frac{3}{4}$	$9\frac{1}{2}$
2	Base, corner blocks (triangular)	$\frac{3}{4}$	3	3
1	Base, end brace	$\frac{3}{4}$	$2\frac{1}{2}$	8
1	Tilting drawer, front	$\frac{3}{4}$	$22\frac{3}{4}$	$23\frac{1}{8}$
1	Tilting drawer, bottom	$\frac{3}{4}$	$9\frac{1}{4}$	22
2	Tilting drawer, sides (fir plywood)	$\frac{3}{4}$	$9\frac{3}{4}$	$22\frac{3}{8}$
1	Tilting drawer, back	$\frac{3}{4}$	$20\frac{1}{2}$	22

Note: All dimensions are given in inches.

Lumber Racks and Storage Bins

By
EDWIN M. LOVE

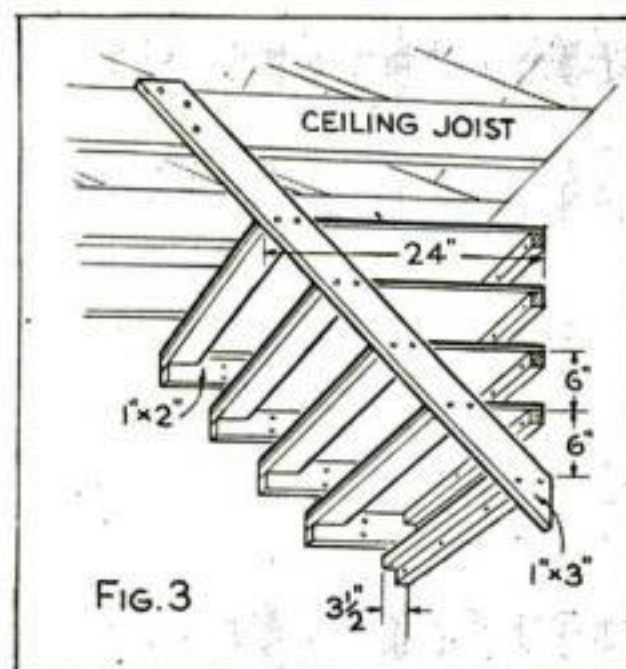


Since the floor of a home workshop is usually occupied with benches and machines and the walls with shelving, a good place for the lumber racks is up near the ceiling

A rack of this type is especially desirable for sheets of plywood so they can be kept perfectly flat until required

A BESETTING problem in the home workshop is the storing of lumber and disposal of waste. Who likes to spend hours of his leisure time sweeping out the workroom or sorting piles of boards when a breakfast set, a garden trellis, or a ship model is about ready for a coat of paint? Yet lumber must be straightened now and then, and piles of sawdust and shavings must be cleaned out. Neatness, in the long run, saves time, and with proper equipment it can be achieved quite painlessly.

This article suggests a variety of inexpensive ways to put order on a paying basis. Lumber should be stored lying down, where it tends to remain unwarped both because of its position and the weight of lumber pinning it down. Plywood must be so racked or it will twist badly and become useless. The method often used of sliding boards under benches or inside brackets is likely to result in crooked stock, and lumber laid on top of roof tiebeams or struts may become cupped because of the superheated air imprisoned above it. Poorly seasoned lumber should be stacked with cleats between the boards to give an even



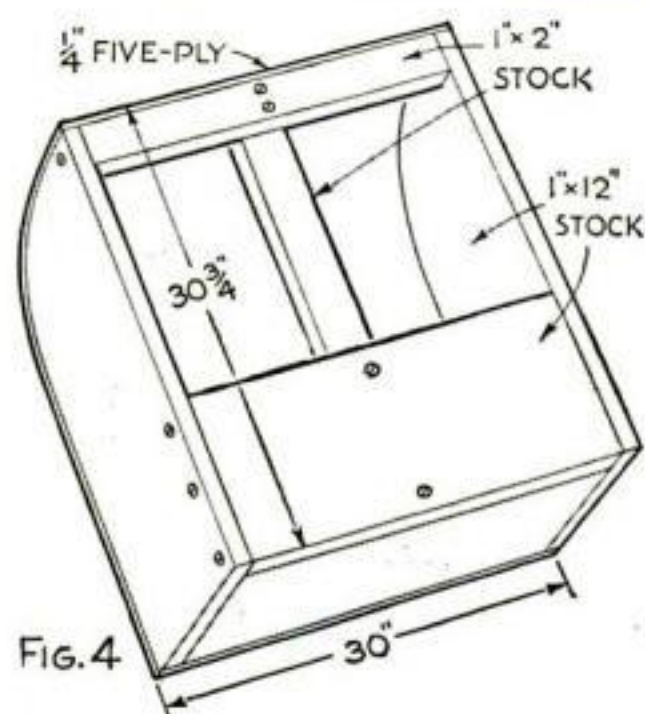
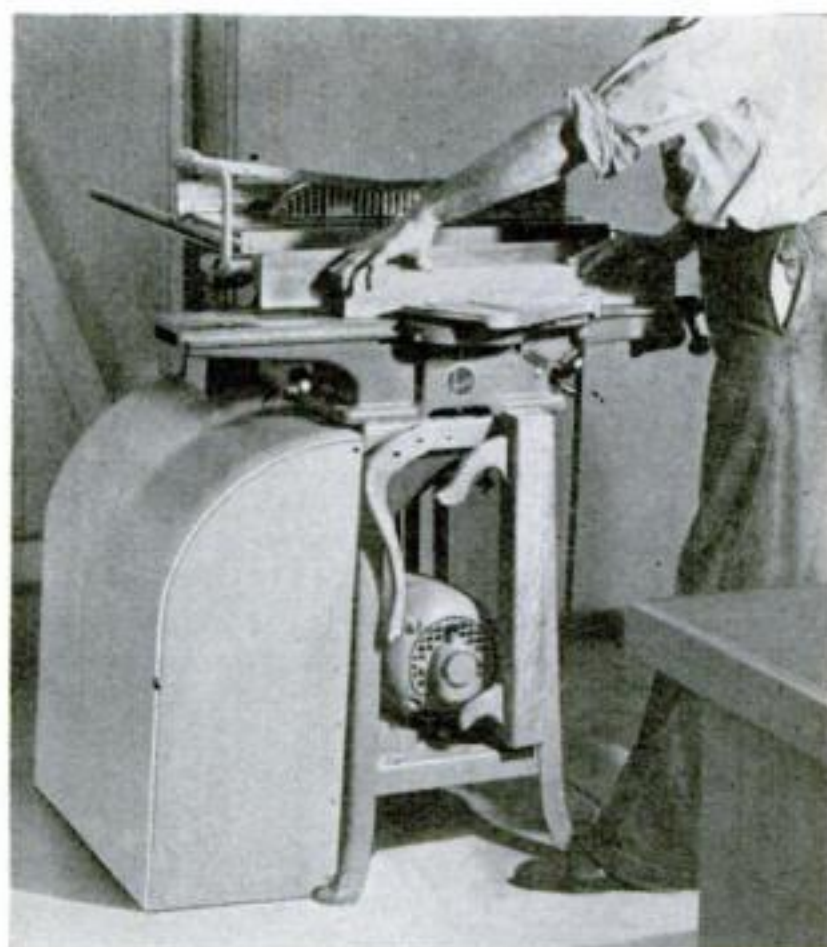
Shelves for storing short pieces so that their size can be seen at once. Below, a shaving and sawdust catcher. It is painted gray like the machines

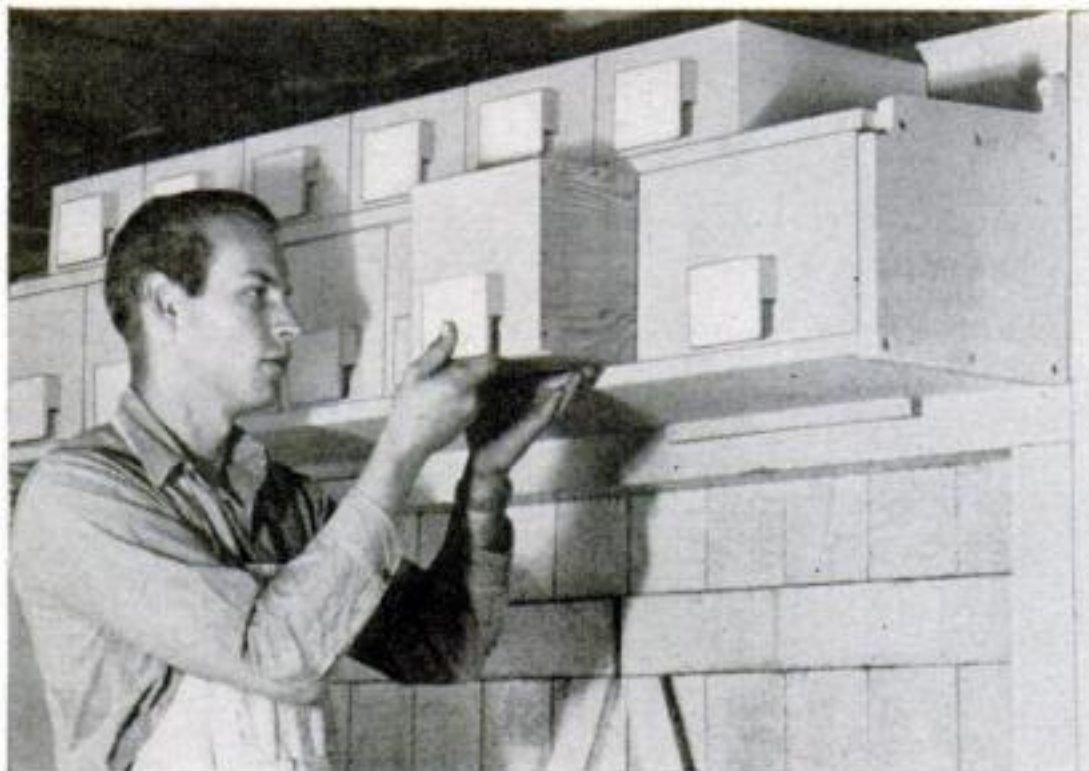
circulation of air through the wood layers.

As with other equipment, racks must fit the available space. The floor is usually occupied with machines and benches, the walls with storage cabinets. There remains the ceiling, and a good place it is to store lumber. Take long stock, for instance. There is almost always a clear run from end to end of the shop near the ceiling. All that is needed to take care of troublesome long boards are some inverted T's built of 1" by 4" material as in Fig. 2. The crossbars should be screwed on the supports, and the supports in turn securely screwed to ceiling joists. Space them about 4' apart. If the ceiling is high enough, two or three crossbars may be used on each support for better division of the lumber. Boards can be removed or replaced from the side, without the bother of threading them through a narrow end opening. Located toward the center, the rack leaves the walls clear.

Figure 1 illustrates a modification for use with plywood. The frames have three lengthwise slats that fully support the sheets and form runways for them. If the rack is put near the center of the ceiling, plywood can be entered or withdrawn from either end. As with the other rack, clearance for lighting fixtures must be taken into account.

Short blocks from 3" to 24" in length are racked in the steplike shelves diagrammed in Fig. 3. The wall and an inclined strip at the other end support cleats that carry shelves made from cheap plywood, box slats, or similar material. Waste blocks can be filed here immediately or thrown temporarily into the scrap bin and then racked





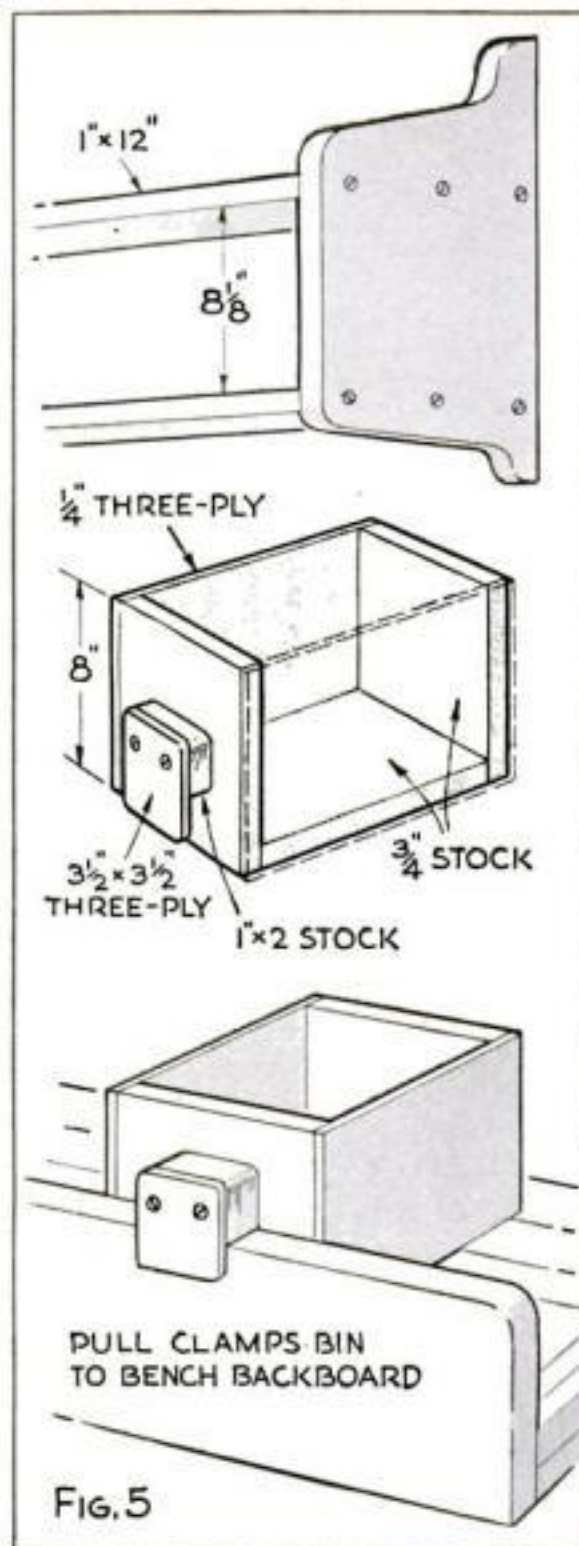
Bins for nails, bolts, lag screws, and other hardware. The handle has been designed so it also serves to hold the bin to the backboard of the bench as in the sketch below at the right

up at the end of the day. Unless some such orderly arrangement is used for saving scraps of lumber, it is quicker and generally more satisfactory to throw out the waste and cut a needed block from larger stock. The rack is very useful even when only 3' long, and may be made as long as space permits.

All these racks might be made from pipe fittings, but such material, although neat and strong, is much more expensive than wood.

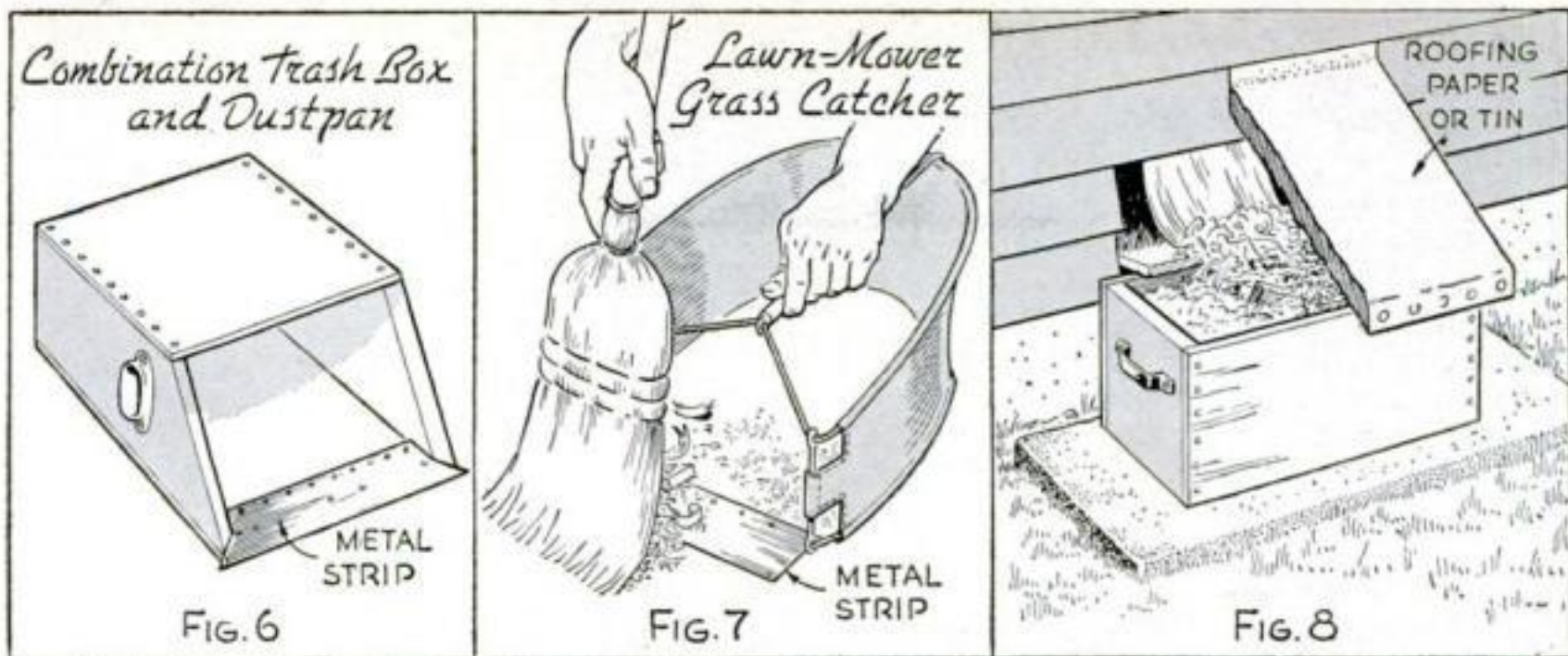
Shavings and sawdust are taken care of by such receptacles as are pictured in the drawings. The design of the catcher in Fig. 4 was contributed by James B. Leeth, of Birmingham, Ala. The construction is self-evident. The cover, with plies running crosswise, is bent around the curved ends of the sides and held with shingle nails or large brads. Caution: Cut a little wide, and dress off the projecting edges after assembly. The dimensions may be varied to suit the machine set-up. The writer, who built one for himself, added an extension to meet the sawdust spout of the circular saw, notched the bottom to fit over the feet of the stand, and put blocks under the outer side to tilt the catcher against the inclined legs. These modifications are shown in one of the photographs. Shavings and sawdust discharge neatly into this container, which keeps much of the litter off the floor.

Figure 6 is a scrap bin that doubles for a dust pan. The metal lip makes snug contact with the floor so that debris is easily swept in. The writer's choice, however, is the lawn-mower type grass catcher in Fig. 7, to which is added a metal lip, and, if needed, a light handle of wooden strips. This capacious pan is light and folds into a flat



Robert Jaacks Gives Report on His Budget Shop

READERS who have been following Mr. Love's series of articles from the beginning will recall that I started my model shop with an initial outlay of \$25 and a monthly budget of \$15. In sixteen months I have acquired a good collection of hand tools; an 8" circular saw with extension table and guard, and a 4" jointer, both on a combination stand and driven by a 1/2-h.p. motor; a 24" scroll saw on a stand with a 1/4-h.p. motor; an 11" wood-turning lathe with a 1/3-h.p. motor, a sanding disk and drum, two faceplates, screw center, keyless drill chuck, grinding wheel, and adapter. I own a dado head for the saw and a set of turning chisels for the lathe. Then there is my workbench, as well as cabinets and racks. By careful buying and by purchasing used motors, I have stretched my funds so that now only \$12 is due on the lathe.—ROBERT JAACKS.



slab that will fit into a narrow opening.

If it can be arranged, the outdoor bin in Fig. 8 is excellent. Cut an opening between studs in an outside wall, slope a board from the floor over the sill to discharge into the box, and make a thin concrete slab for a base. The inside is closed with a hinged board locked with a hook. The fixed hood, covered with tin or roofing paper, protects the box from the weather.

The shelf-and-box arrangement in Fig. 5 solves the nail-bin problem and is useful for orderly storage of many other odds and ends treasured by the home mechanic. If neat containers, such as chisel boxes or cartridge boxes, can be obtained, the shelves should be made to fit. For our model shop, bins were built as in the drawing, the lower ones about 8" deep, the others 5". The pulls are glued and nailed, and serve as hooks to hold

a bin to the back-board of the bench, clear of the top, yet conveniently at hand.

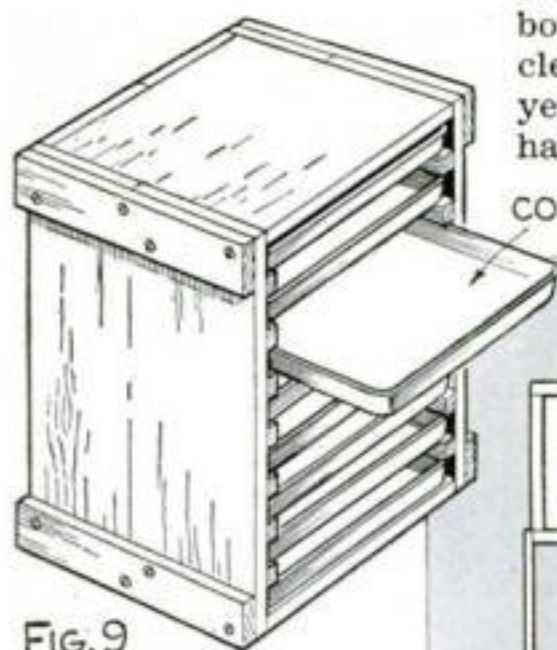


FIG. 9

A small cabinet with cookie tins for drawers and, at right, a case made by stacking eight small boxes

Shelves carrying coffee or honey cans, bottles, and many other forms of discarded commercial containers can be adapted for storage.

Packing boxes of various sizes make good filing cabinets for various items. In Fig. 9 cookie tins, costing ten cents each, are drawers for storing small flat articles. The tins slide on cleats nailed to the sides of the box. Cake tins, cup-cake and gem tins, or paste shoe-polish cans assembled on rectangles of plywood can be used in the same way to hold small nails and screws. In this case it is well to provide each with a plywood cover, or to separate the drawers with thin shelves, to prevent the contents of the cups being spilled or mixed when opening or shutting.

In Fig. 10 an arrangement of eight boxes making fifteen compartments is shown. The open sections rest on the bench below, and the upper ones are closed with pieces of plywood wall board nailed on. The open ends are either closed in the same way or filled with 1" stock to make them flush.

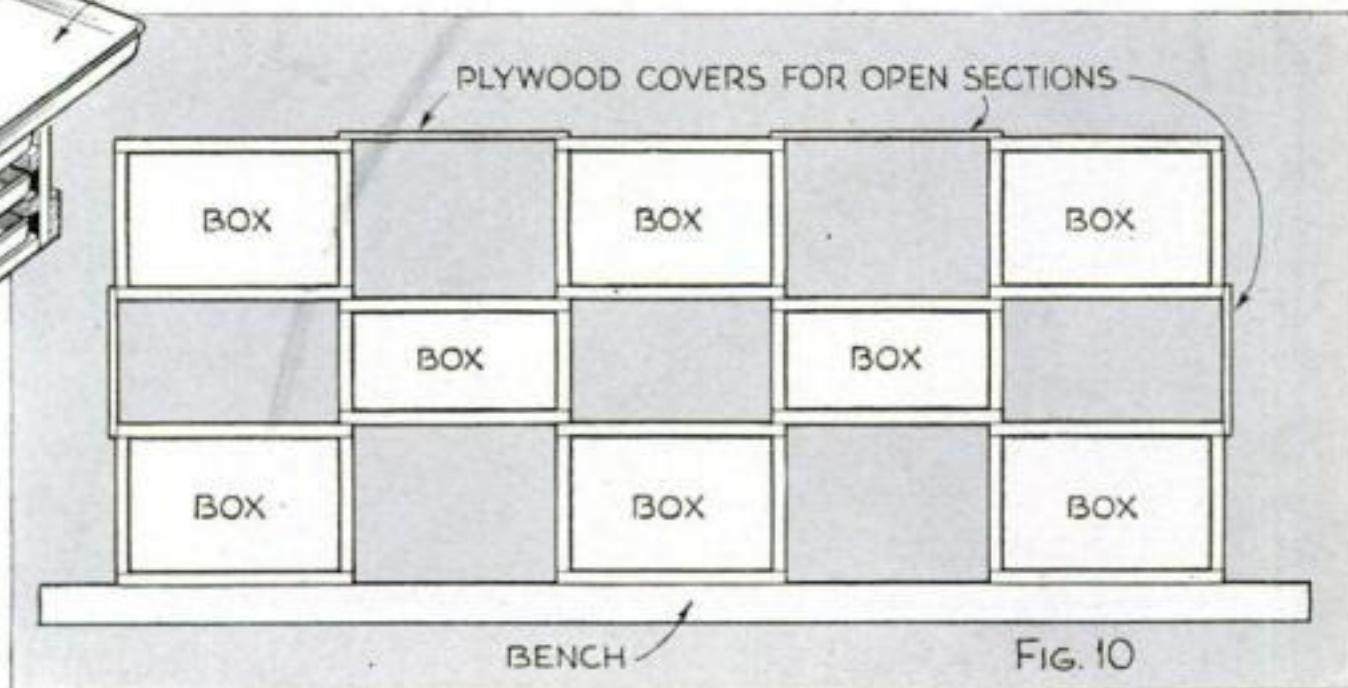
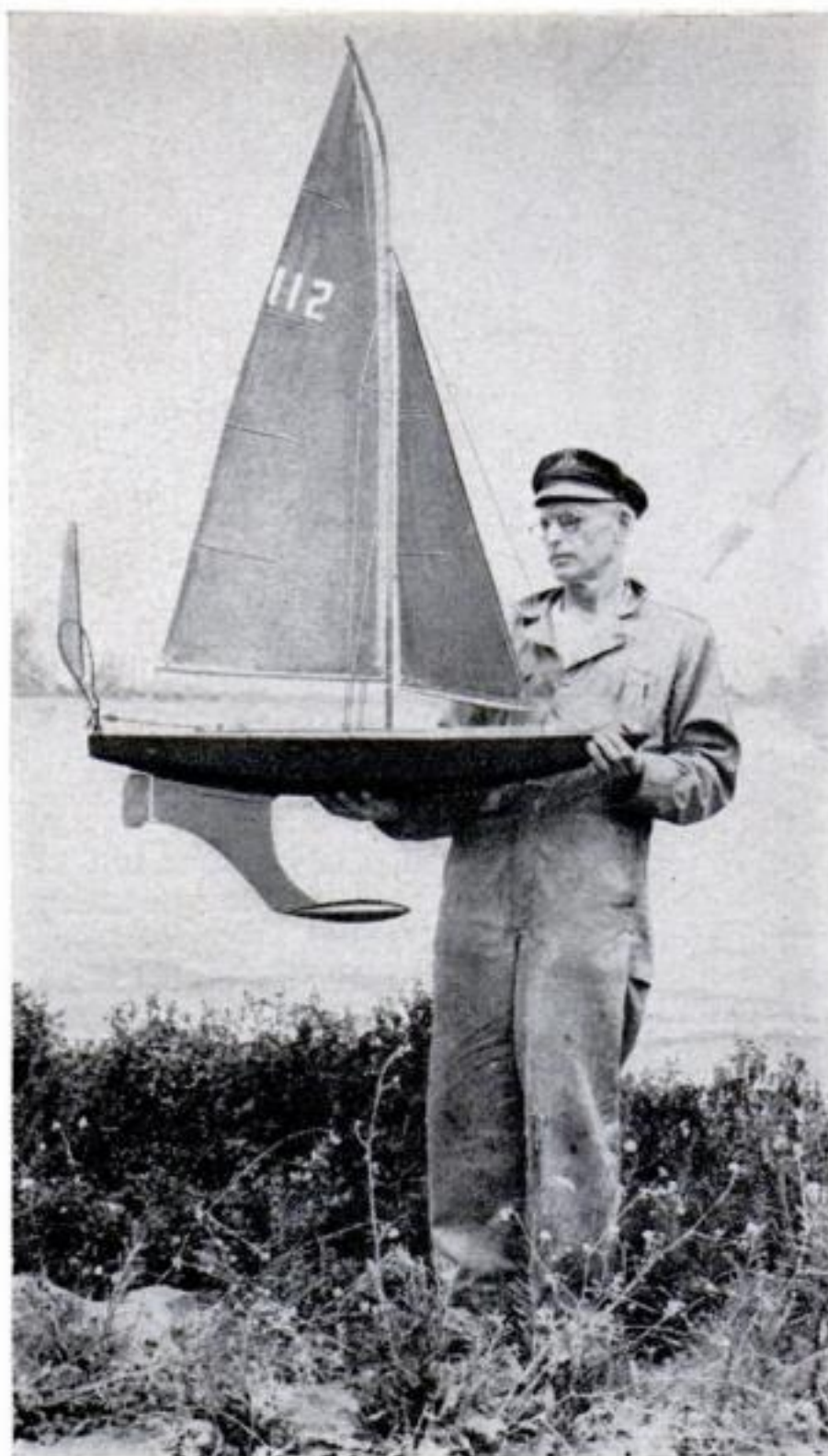


FIG. 10

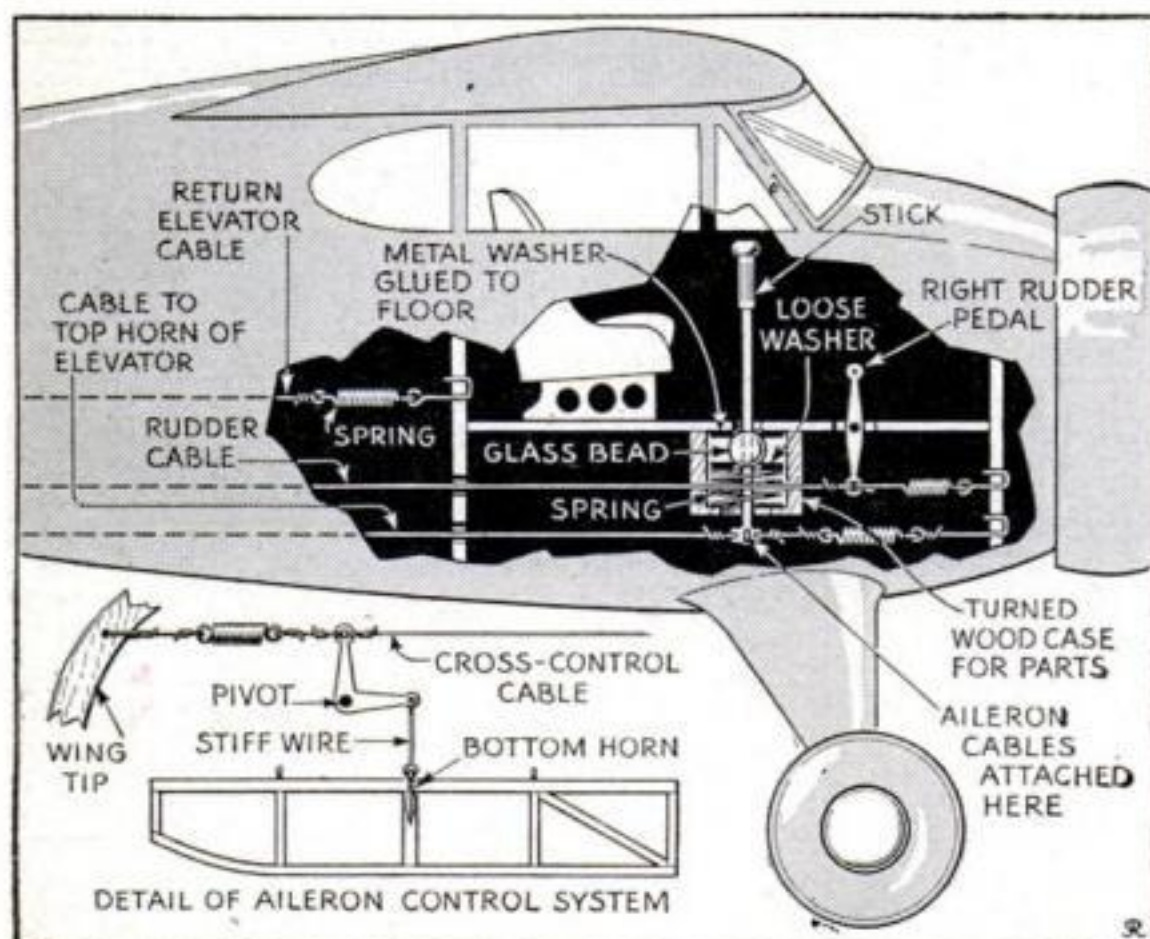
Novel "Finless Fin" Keel Improves Model Yacht

IT HAS always been the aim of model-yacht designers to incorporate such features in their designs as would make the finished yacht "balanced." This quality, reduced to fundamentals, means an inherent ability of a vessel to sail the course desired. The main effort of the designers has, in general, been restricted to maintaining the center of buoyancy, under all angles of heel, in the same plane athwartships. This method, however, has not been found all-sufficient, and some of the more scientific experimenters have been trying to work out a formula that would prove more satisfactory under the actual conditions of sailing.

Delving deeply into the factors of balance, A. Lassel, of Wilmington, Calif., has built and sailed fifty models in order to experiment with different arrangements and theories, particularly those relating to the keel and skeg. He has come to the conclusion that the skeg is the principal agent of balance, and that what may be called a "finless fin" keel is not only practical, but superior to any other type by a wide margin. He bases this on tests that showed the range over which the center of effort traversed in maintaining balance under all wind conditions.—R. B. DABBS.

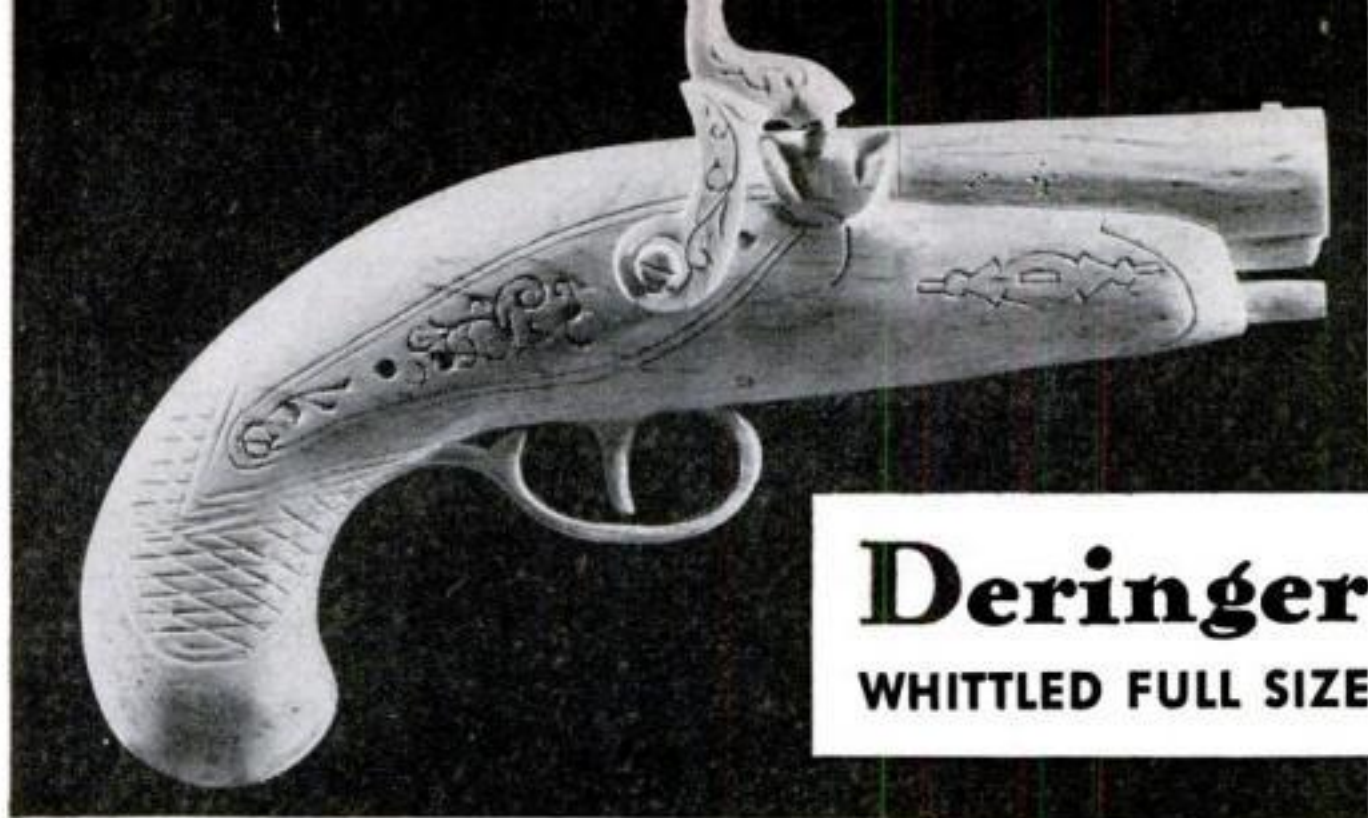


Installing Controls That Really Work in a Scale Model Airplane



It is usually a very difficult and discouraging task to build working controls into a replica model airplane. The system illustrated, however, looks to all outward appearances a duplicate of the real thing.

Fine music wire or very fine braided copper wire should be used for cables. Small coil springs keep the controls tight and centered when not in use. For the rudder controls, a cable runs directly from each pedal to the control horn on the corresponding side of the rudder surface. Matched tension springs, fastened to a forward bulkhead, recenter the rudder.—C. L. HOLLMANN.



This
of
7 1/16"
in one
for th

Deringer Pistol

WHITTLED FULL SIZE FROM WOOD

BECAUSE of its delicate design and markings, this model of a Deringer cap-and-ball pistol has been made full size. It is only 7 1/16" long.

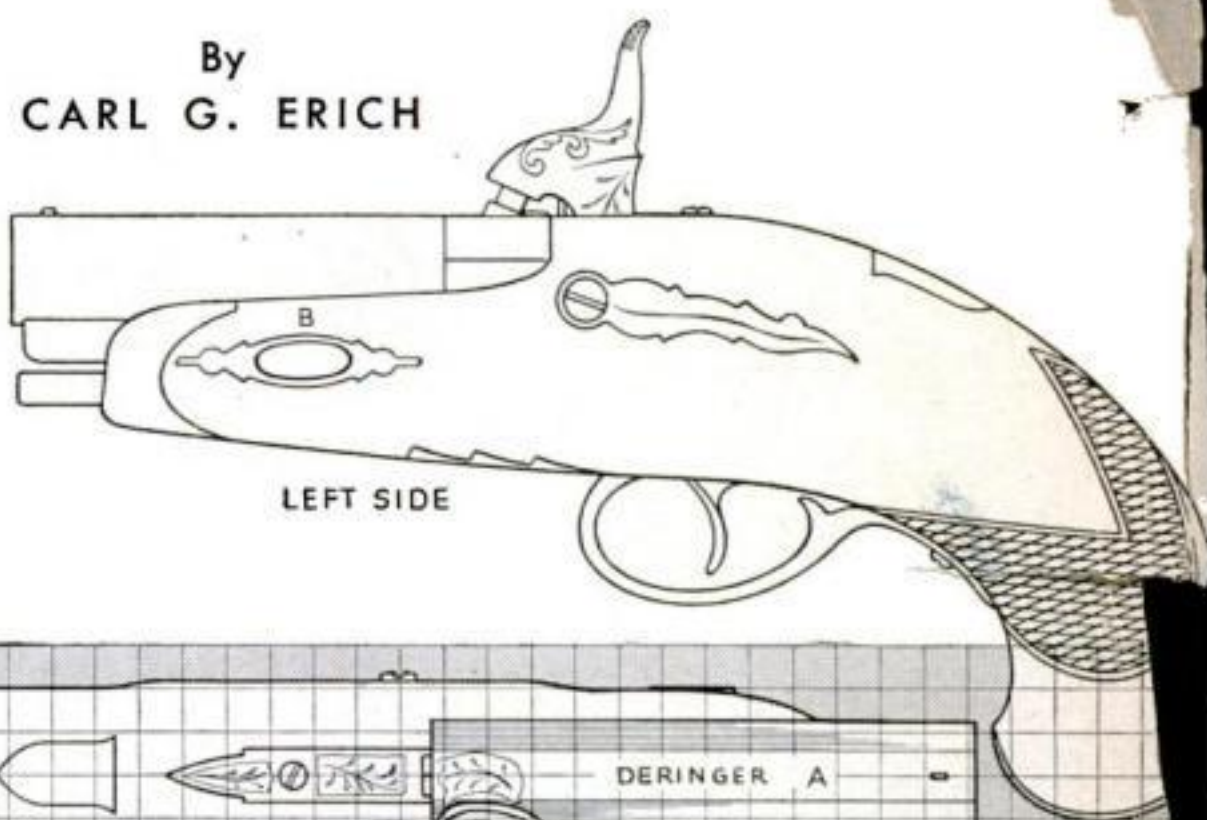
Transfer the design to a white pine board 1 1/8" thick. Bore a hole on the inside of the trigger guard and jig-saw this first; then saw the entire outline. Draw a center line all the way around to act as a guide, and make three cardboard templates to help obtain the correct contours when carving the shape.

Notice that the stubby barrel has a flat surface 1/2" wide on top (A) and that the rifling is seven-sided. The plates B on opposite sides of the pistol have identical outlines, but the projecting center portions differ.

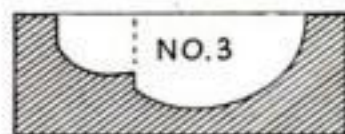
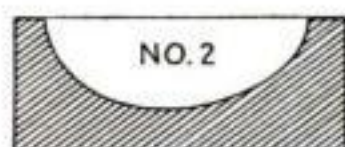
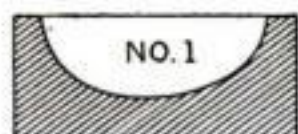
Make the hammer separately and fasten it in place with glue

and a short piece of dowel shaped at one end like a screw. The hammer leans over the barrel in order to come directly above the cap holder. Use pieces of dowel for the cap holder screws. The name stamped on the pistol is correctly, "DERINGER," although the word is commonly spelled "derringer" when used to designate a pistol of this general type.

By
CARL G. ERICH

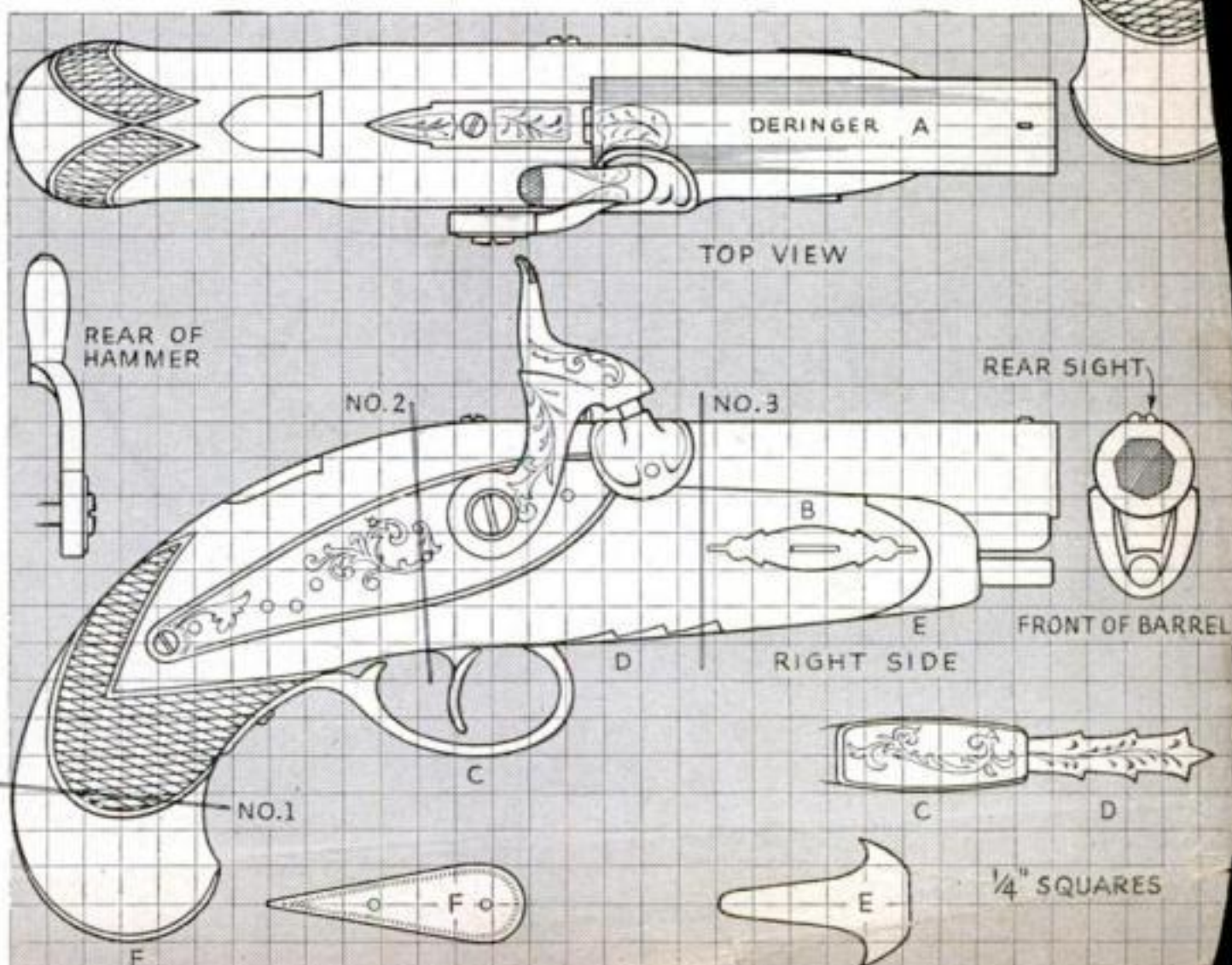


LEFT SIDE

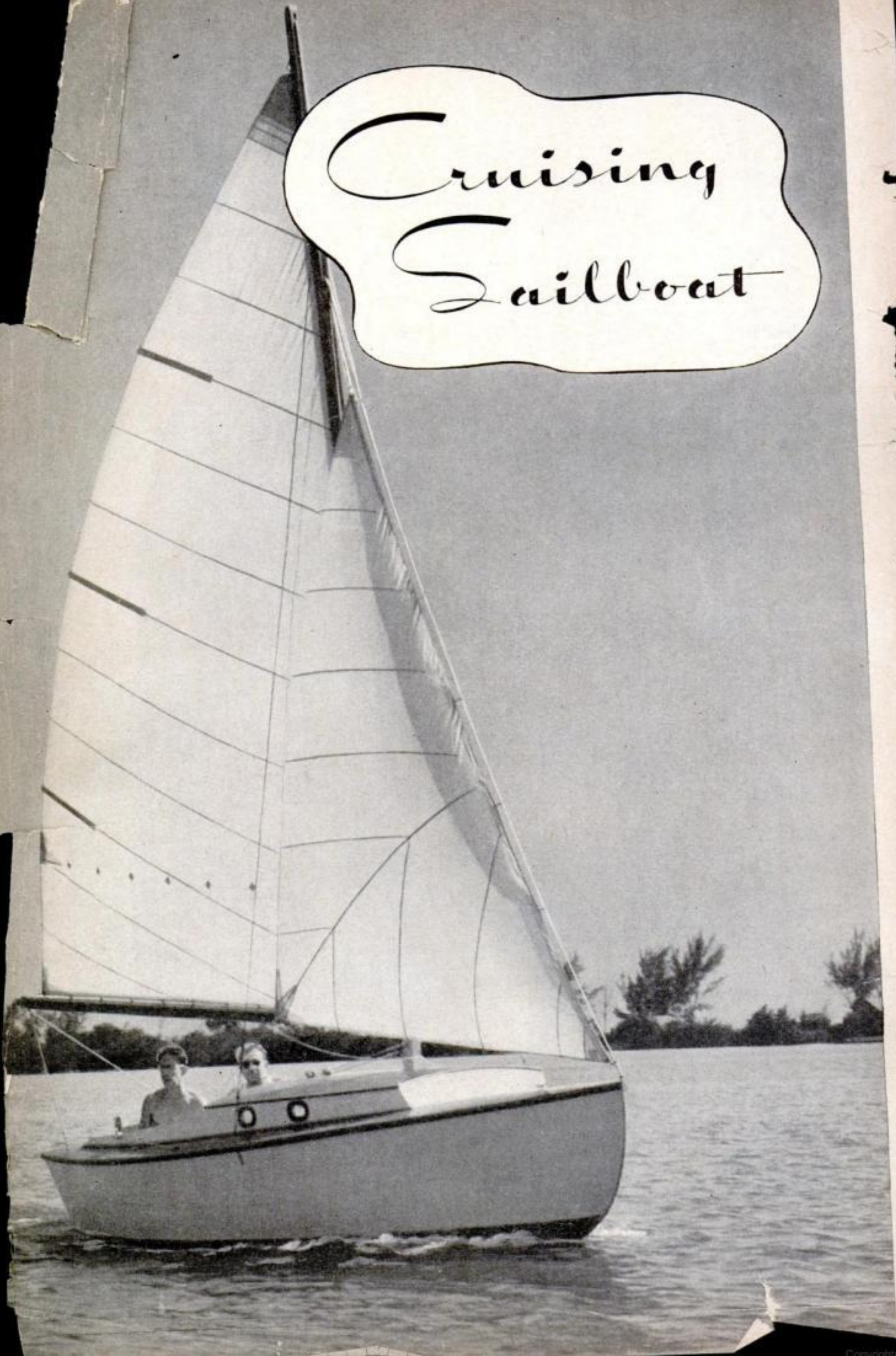


TEMPLATES 1/2 SIZE

Cardboard templates should be prepared to aid in shaping the pistol to the right shape



Cruising Sailboat



A FAST NINETEEN-FOOT CABIN SLOOP FOR INLAND AND OFFSHORE WATERS...USES OUTBOARD OR INBOARD MOTOR

PART I

By Bruce and
Willard Crandall

THE new POPULAR SCIENCE cabin sailboat *Whitecap* is ideally suited either for day sailing or for extended cruising over varied waterways. If you build this beautiful 19' craft—and it is fortunately quite easy to construct for a boat of its size—your vacation problems will be solved. The waterproof cabin offers a small, but comfortable home for as long as you wish to stay afloat.

The design is exceptionally seaworthy, and the full 7' beam provides sufficient stability to withstand any sudden blow. The modern Marconi sloop rig and perfect balance assure, for both light and heavy winds, a combination of unusual speed and excellent handling qualities under sail.

A small outboard or inboard motor may be used as auxiliary power. Unless the motor is to be run a great part of the time, an outboard is preferred, as it will not cause any drag while the boat is under sail.

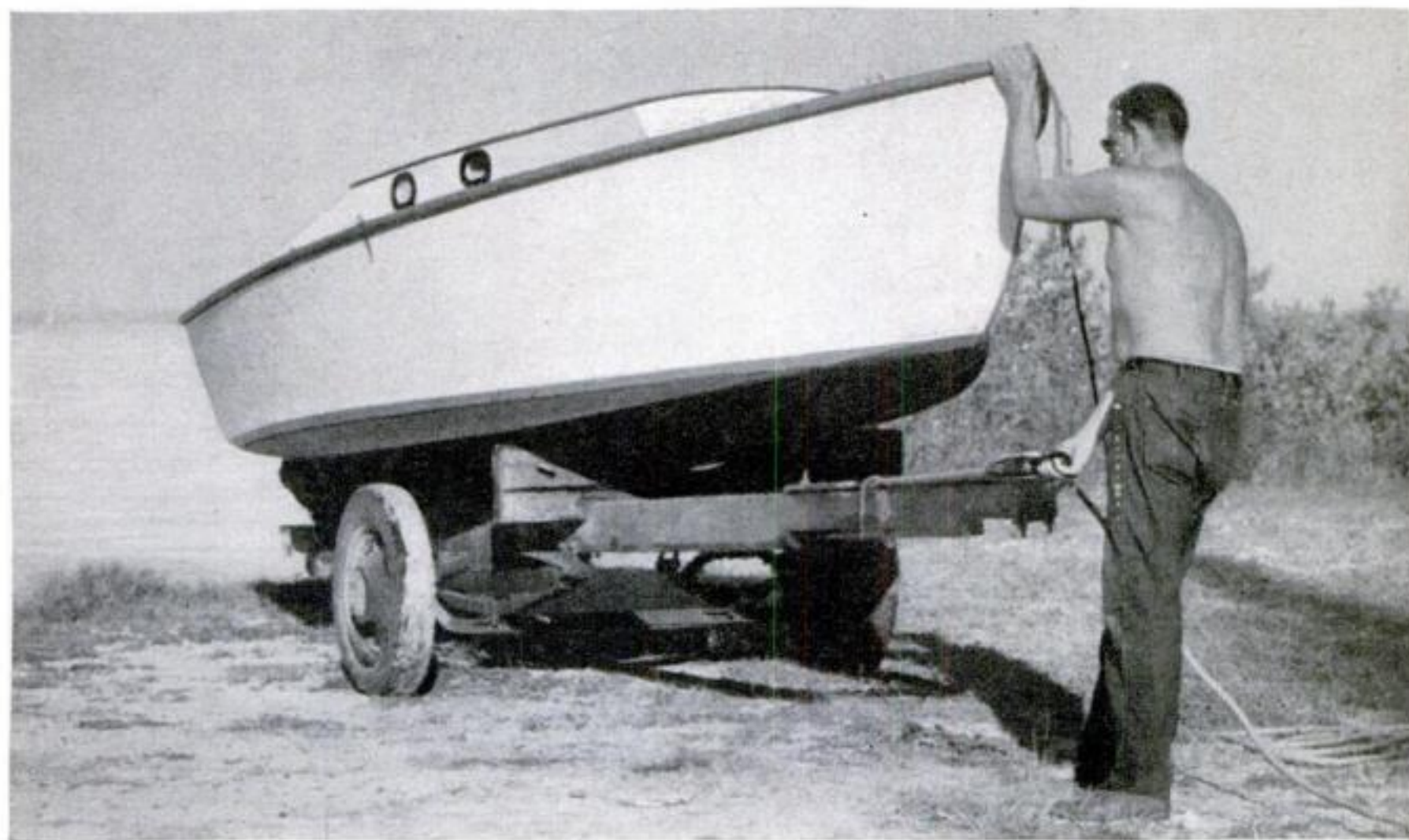
Two permanent bunks are provided in the cabin. On extended cruises a canvas cover can be erected over the cockpit, the boom being used as a ridge pole. This will make the cockpit serve as part of the cabin, and sleeping accommodations can then be ar-

ranged for one or two additional persons provided the cockpit seats are extended to form extra bunks.

Largely because of the extensive use of waterproof plywood, the entire boat can be built to weigh as little as 700 lb., or even considerably less if plywood is used for planking as well. The boat is light enough to be carried on a two-wheel trailer.

The construction of the boat has been kept extremely simple. No plank splicing, spiling, or difficult bends are required. The steam-bent outside stem, shown in the drawings and photographs, is used so as to eliminate the cutting of a rabbet and the fitting of the plank ends into the rabbet. However, a rabbeted stem may be substituted, if desired, thus doing away with the steam bending.

In districts in which lumber is not too expensive, the entire boat may be built for \$150 or less. This includes galvanized fastenings and fittings as well as sails made by a professional sailmaker. The cost, of course, would be much greater if only the best quality materials are used, while the taller of the two sail plans to be given in



"Whitecap" is light enough to be carried and launched easily from a two-wheel trailer. The boat is well suited for day sailing and extended vacation cruises, and is fast under all weather conditions

a later installment, or an inboard installation, would also add considerably to the total expense.

Before ordering your materials, find out what kinds of lumber are most reasonable in your locality and check over the list so you can make what changes are necessary, if any, for the type of construction you intend to use.

If desired, the entire boat may be drawn full size before starting construction by using the table of offsets and accompanying

drawings, and deducting the thickness of the planking from the full-sized drawings. This is not necessary, however, as this work has already been done. All that is really required is to draw full-sized patterns of the frames, stem, and transom, or purchase the patterns already drawn.

For drawing each frame pattern, use a large sheet of wrapping paper folded in the middle so the fold will represent the center line. Draw the side and bottom frames, floor ties, and chine knees on one side ac-

MATERIALS FOR THE CRUISING SAILBOAT

This list is for the boat shown in the photographs. Materials for inboard installation, and for the larger of the two sail plans to be shown, are not included. All materials are listed in order of preference.

LUMBER

White cedar, mahogany, cypress, red cedar, white pine, fir, spruce, or redwood.

For	No. Pc.	Size
Planking and floor boards	2	1/2"x or 5/8"x10"x20'
	6	1/2"x or 5/8"x8"x20'
	4	1/2"x or 5/8"x6"x18'
	4	1/2"x or 5/8"x4"x18'
	4	1/2"x or 5/8"x6"x16'
Battens	6	1/2"x or 5/8"x8"x16'
	8	1/2"x1 1/2"x20'
	8	1/2"x1 1/2"x18'
Coaming	4	1/2"x1 1/2"x16'
	2	3/4"x or 7/8"x10"x14'

White oak, mahogany, spruce, yellow pine, fir, cypress, or white pine.

Frames, floor ties, chine knees, and deck and cabin beams	120 lin. ft.	3/4"x or 7/8"x2 1/2"x
Rudder	1	3/4"x or 7/8"x6"x16'
Keelson	1	3/4"x or 7/8"x10"x16'
Keel	1	3/4"x or 7/8"x8"x16'
Carlings, seat and bunk framework, and misc.	5	3/4"x or 7/8"x1 3/4"x16'
Chines	2	3/4"x or 7/8"x1 3/4"x20'
Skeg, sternpost, and mast step and partner	1	1 1/8"x or 1 1/4"x10"x10'
Centerboard-trunk bed logs	1	1 3/4"x3 1/2"x10'
Inside stem	1	2 3/4"x6"x6'
Outside stem (white oak)	1	3/4"x1 3/4"x6'
Molding (half-round)	2	1 1/2"x20'
	2	5/8"x12'
Molding (quarter-round)	2	5/8"x14'

Marine plywood—mahogany or fir.

Centerboard trunk, seats, and floor boards	1	3/8" or 1/2"x4'x8'
Cabin top and bunks	2	1/4"x4'x8'
Deck	3	1/4" or 3/8"x4'x8'

Spruce, fir, cypress, or white pine.

For	No. Pc.	Size
Mast	2	1/2"x4"x24'
	2	3/4"x1 1/4"x24'
	1	1 1/4"x2 1/4"x8'
Boom	2	3/4"x3"x12'

Any cheap lumber.

Keel form	1	1"x10"x18'
Uprights and braces	4	1"x2"x16'

*These measurements are net.

FASTENINGS

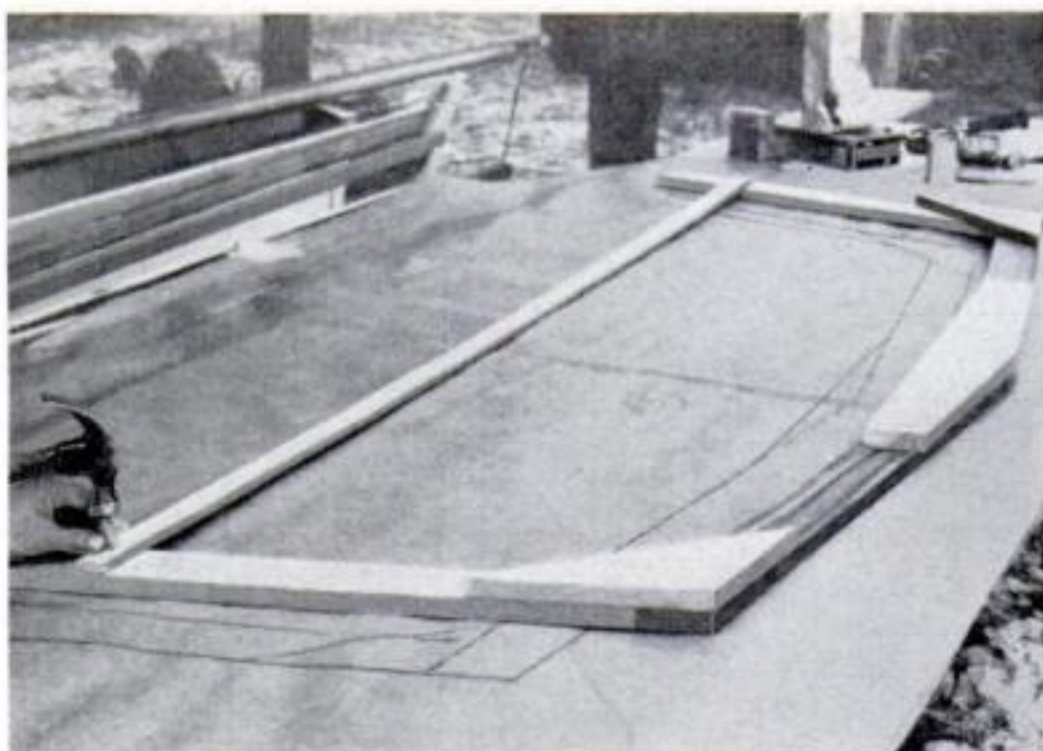
Flathead bronze, brass, or galvanized-iron wood screws as follows: 5 gross 1 1/4" No. 8, 7 gross 1 1/2" No. 8, 2 gross 2" No. 10, 1 gross 2 1/2" No. 12, 2 doz. 3" No. 12, 1 gross 1 1/2" No. 10 or 1 gross 2" No. 10 machine screws and 1 gross No. 10 hexagon nuts. 1 gross 3/4" No. 6 roundhead brass screws for sail track. Copper or galv. nails as follows: 3 lb. 1", 8 lb. 1 1/4", 2 lb. 1 1/2". Also 20—1/4"x5 1/2" galv. carriage bolts with washers. Galv. machine bolts with washers as follows: 2—1/4"x4", 2—1/4"x8", 1—1/2"x6", 1—3/8"x3", 4—3/8"x12". A 4' length of 5/8"x3/16" half-oval, brass or galv. iron; 6' of 1/4" galv.-iron rod; 3' of 3/8" brass or galv.-iron rod.

MISCELLANEOUS

6—4" open-base cleats; 1—6" open-base cleat; 1 pr. 4" bow chocks; 1—1/4" No. 0 cheek halyard block; 1—3/8" No. 2 cheek halyard block; 1—2" sheave; 2—1/4" fast-eye blocks; 3—1/4" swivel blocks on plate; 3—1/4" screw anchor shackles; 1—1/4"x3" shoulder nut eyebolt; 3—5" chain plates; 6 No. 2 closed wire-rope sockets; 3—1/4"x4" turnbuckles, open-pattern shackle and shackle; 2 No. 1 boat snap hooks; 2 lip leaders; 2—10' lengths and 1—12' length of 5/8" sail track; 60' of 3/16" galv. rigging; 120' of 1/4" manila rope; 50' of 3/8" manila rope; 3—3/4" strap gudgeons; 1 screw gudgeon; 1 lb. marine putty; 1/2 gal. liquid aviation marine glue; 7 yd. cotton flannelette; 1 pt. resin glue or 1 lb. casein glue; 2 1/2 gal. marine paint and spar varnish; centerboard, 1/4" bronze, galv. iron or boiler plate.

SPECIFICATIONS IN BRIEF

Length (over all).....	19' 0"
Length (water line).....	17' 1"
Beam	7' 0"
Draft to bottom of skeg....	9½"
Draft to bottom of rudder..	1' 10"
Draft (centerboard down)..	3' 4"
Freeboard (bow).....	2' 6"
Freeboard (stern).....	2' 0"
Cost of materials.....	\$150—\$175
Weight	700 lb.
Motors, outboard or inboard	1—4 h.p.
Speed under power.....	3-8 m.p.h.
Sail area.....	152 sq. ft.



The frames are assembled over the patterns, and temporary strips, with the center line marked, are nailed across the top

according to the measurements given in the drawings. Punch through at the important points, unfold, and draw the other half.

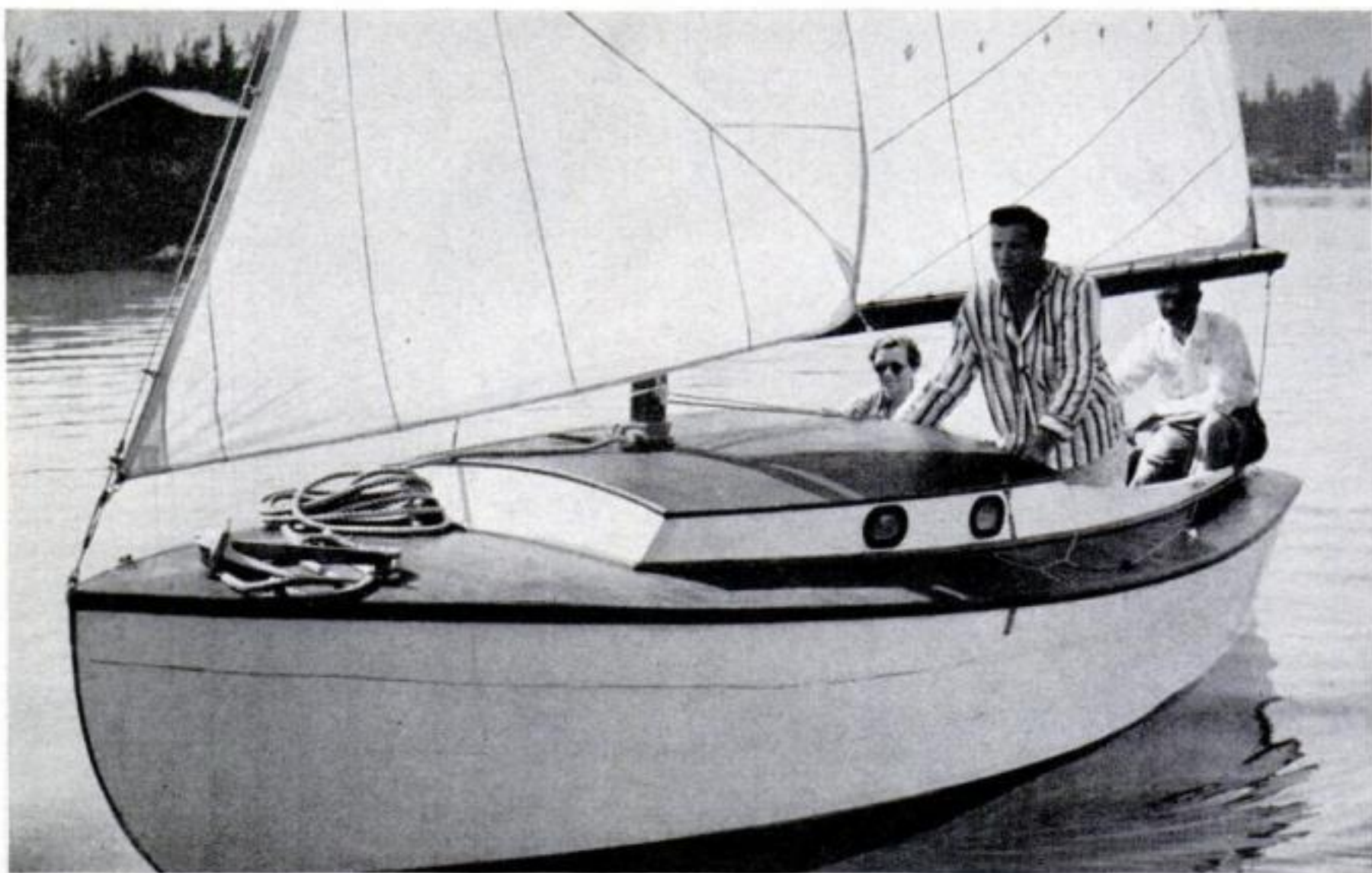
As there are no curved frames, all that is necessary now is to lay the 2½" frame material over the patterns and mark the correct lengths and angles. All measurements for the floor ties and chine knees are also taken from the paper patterns with the aid of a bevel square. The frames should be in position over the patterns while being fastened together. For this use 1½" No. 10 flathead screws, 2" No. 10 machine screws, or carriage bolts, as preferred. These fasten-

ings should all be set in enough to allow for the keelson, chine, and batten notches, and for the beveling of the forward frames.

Screw the transom planking to the transom framework with 1¼" No. 8 screws spaced about 3" apart. Coat the surfaces to be joined with marine glue or thick paint.

Nail temporary pieces across the top of all side frames and mark the center line on these pieces and on the transom. Notches for the keelson can now be cut in the exact center of each bottom frame and floor tie, but not into the transom planking.

(TO BE CONTINUED)



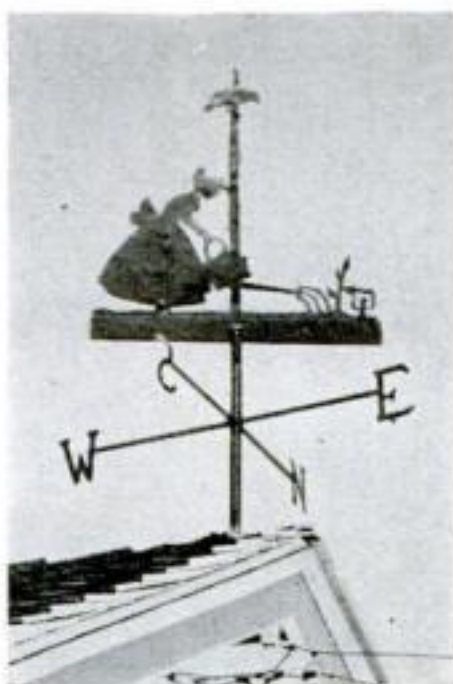
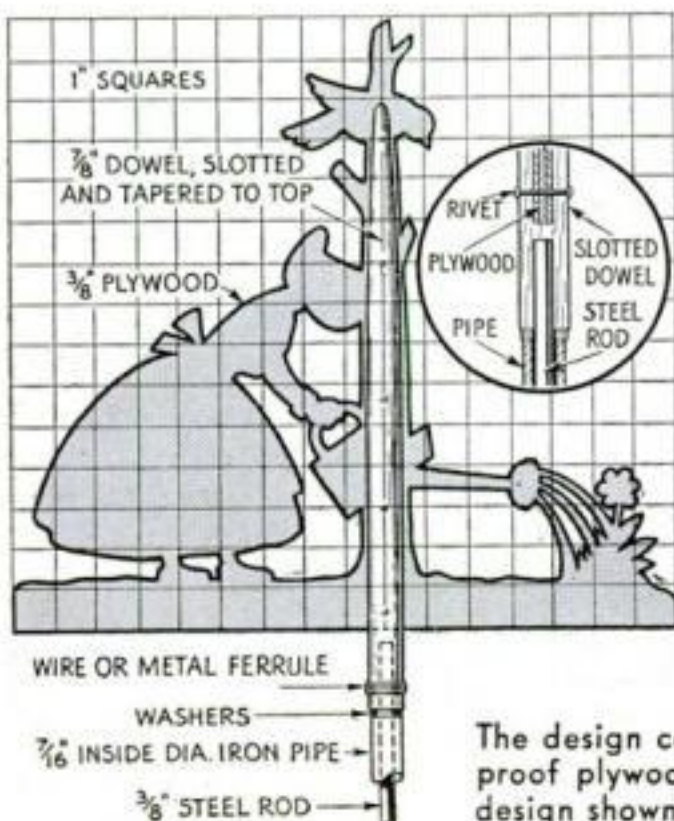
"Mary, Quite Contrary" Is Theme of Plywood Weather Vane

ALTHOUGH weather vanes are usually metal, this one is so designed that it can be scroll-sawed from $\frac{3}{8}$ " five-ply waterproof (resin-bonded) plywood. It is riveted to a

$\frac{7}{8}$ " dowel, which serves as a shaft. The bottom of the dowel is drilled to receive a $\frac{3}{8}$ " steel rod, and the rod fitted in a pipe with a $\frac{7}{16}$ " hole. Two or three washers with $\frac{7}{16}$ " holes serve as bearing plates. Steel wire is tightly wrapped around the part of the dowel that is drilled to prevent it from splitting, or a ferrule may be used.

After the edges are sanded, the plywood is thoroughly coated with aluminum paint, especially the edges. Then oil paints are applied, with ample drying time between the several coats.

Of course, the weather vane can be cut out of metal, and welded or riveted to the shaft, and minor details of the design altered.

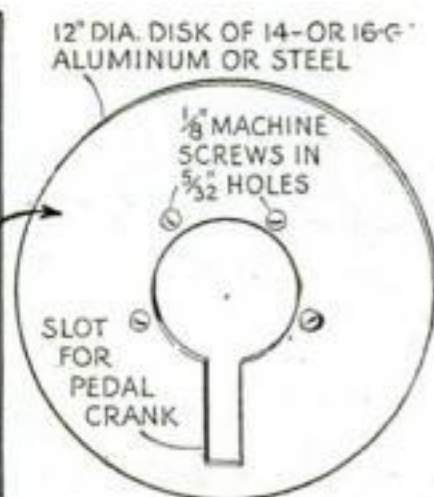


The design can be scroll-sawed from waterproof plywood or cut from thin metal. The design shown in the photograph is of metal

Disk Sprocket Guard Protects Bicycle Rider's Trousers

SOME messengers, newsboys, and others who ride bicycles constantly in traffic and in all sorts of weather prefer the disk type of sprocket guard illustrated. When it is used, the bottom of floppy trousers legs will not catch on the exposed sprocket teeth and be drawn up to entangle the chain. The disk is preferred to the usual long channel-type metal guard because the latter does not cover the exposed rear half of the front sprocket.

Spacing washers hold the disk about $\frac{3}{16}$ " out from the sprocket. Round the edges of the finished guard and paint it to match or contrast with the bicycle.—R. K.



The disk guard prevents the rider's trousers from catching in the sprocket and resulting in a tumble



Dual-Tired Truck Wheels Tamp Refill Dirt into Long Trench

WHEN a long trench must be refilled and tamped, as after installing water pipe, a dual-tired truck may be used effectively. The trench should first be filled about level with loose earth, and the truck tires passed back and forth over it two or three times. Then fill the trench a few inches above level and again pack it down.—R. B.

Brick Priming Needs Dry Weather

Two or three dry days should precede the priming of new brick on a house or wall. Never attempt to prime or apply the regular paint coats in very cold weather.

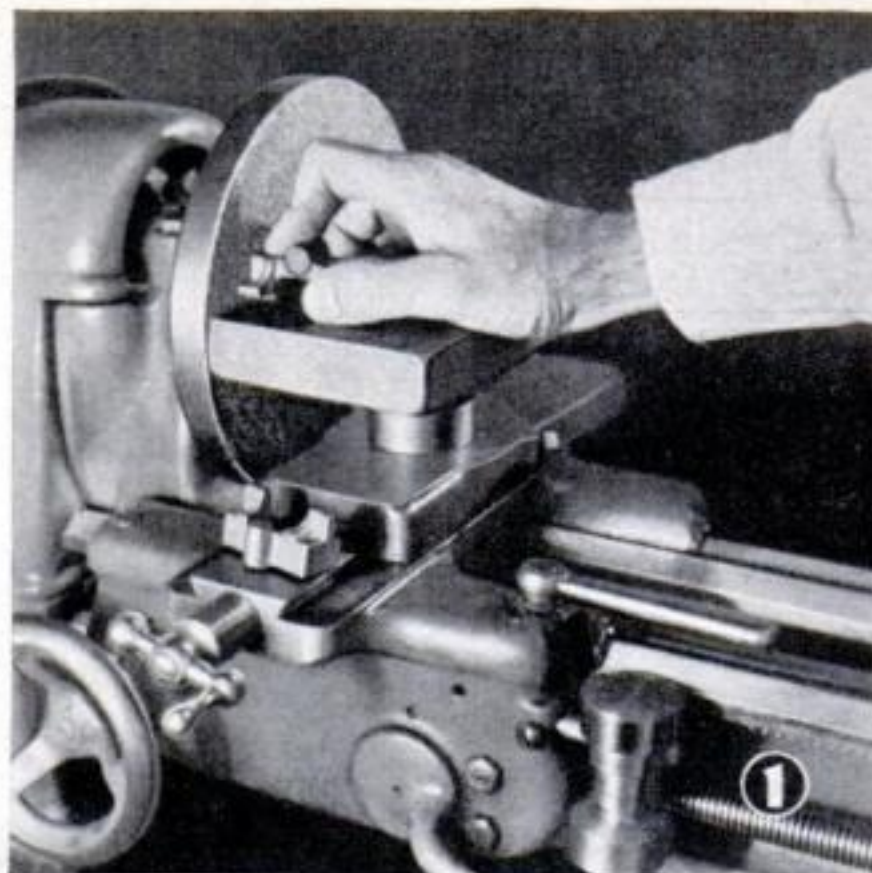
Sanding Disk and Cross-Slide Table



The castings after they have been machined

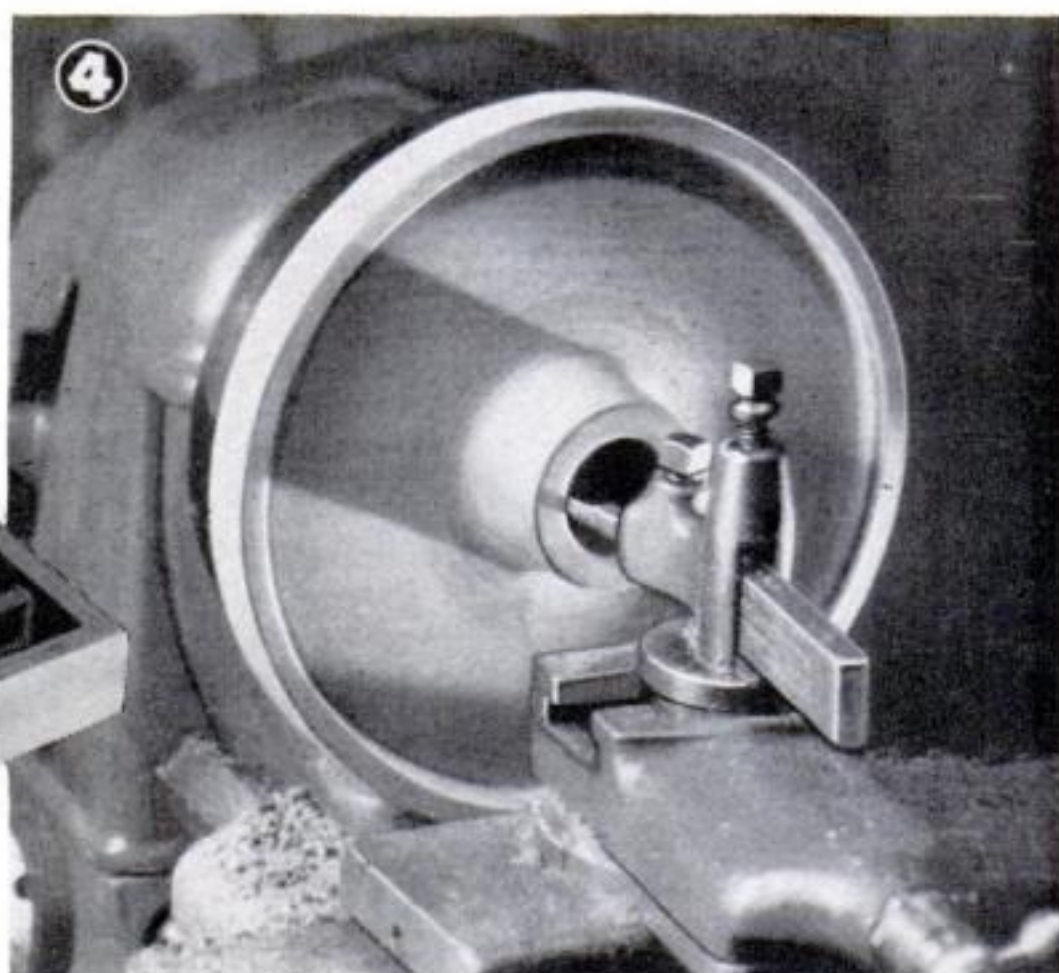
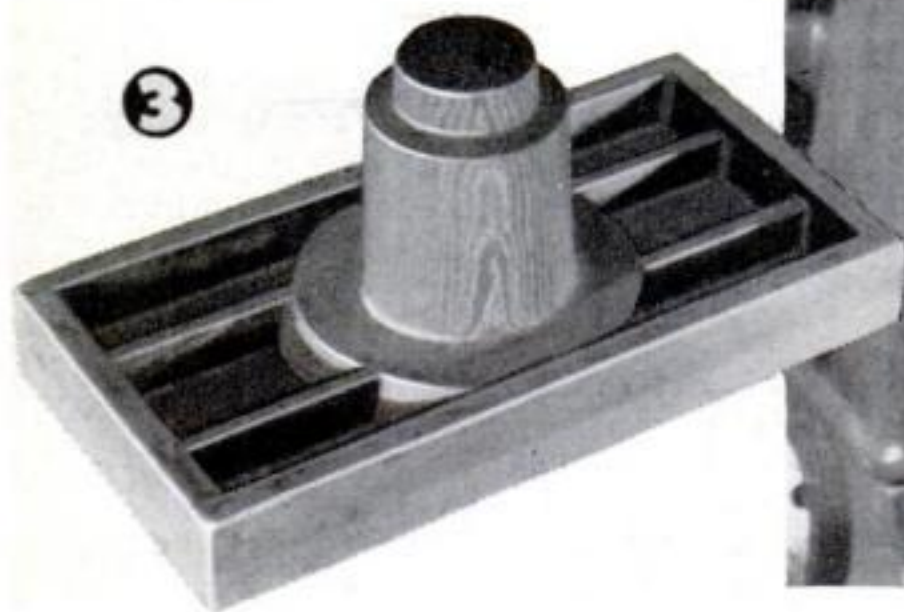
MANY small parts can be given a fine, accurate finish on a sanding disk made up to fit your metal-cutting lathe as shown in Fig. 1. As this attachment can be used equally well on wood, plastics, or metal, it will be a worth-while addition. Only two inexpensive gray-iron castings are required, and all the machine work can be done on the lathe itself.

Wood patterns must be made for the castings. In this case the disk was turned from a piece of solid cherry (Fig. 4) to the dimensions in the drawings. It was well sanded



and shellacked before being removed from the lathe. The standard for the cross-slide table (Fig. 3) was also turned in the lathe, and the table top built up around it. The dimensions were arrived at by laying out the table top to come within a 9" circle (the swing of the lathe) so the job could be machined without having the work done outside.

About $3/32$ " should be added to the thickness of the patterns to allow for machining, and it is important that they have proper draft or slight taper so they can be drawn from the molding sand. All sharp inside



corners should be smoothly filled out with beeswax, and the whole given several coats of hard-drying shellac.

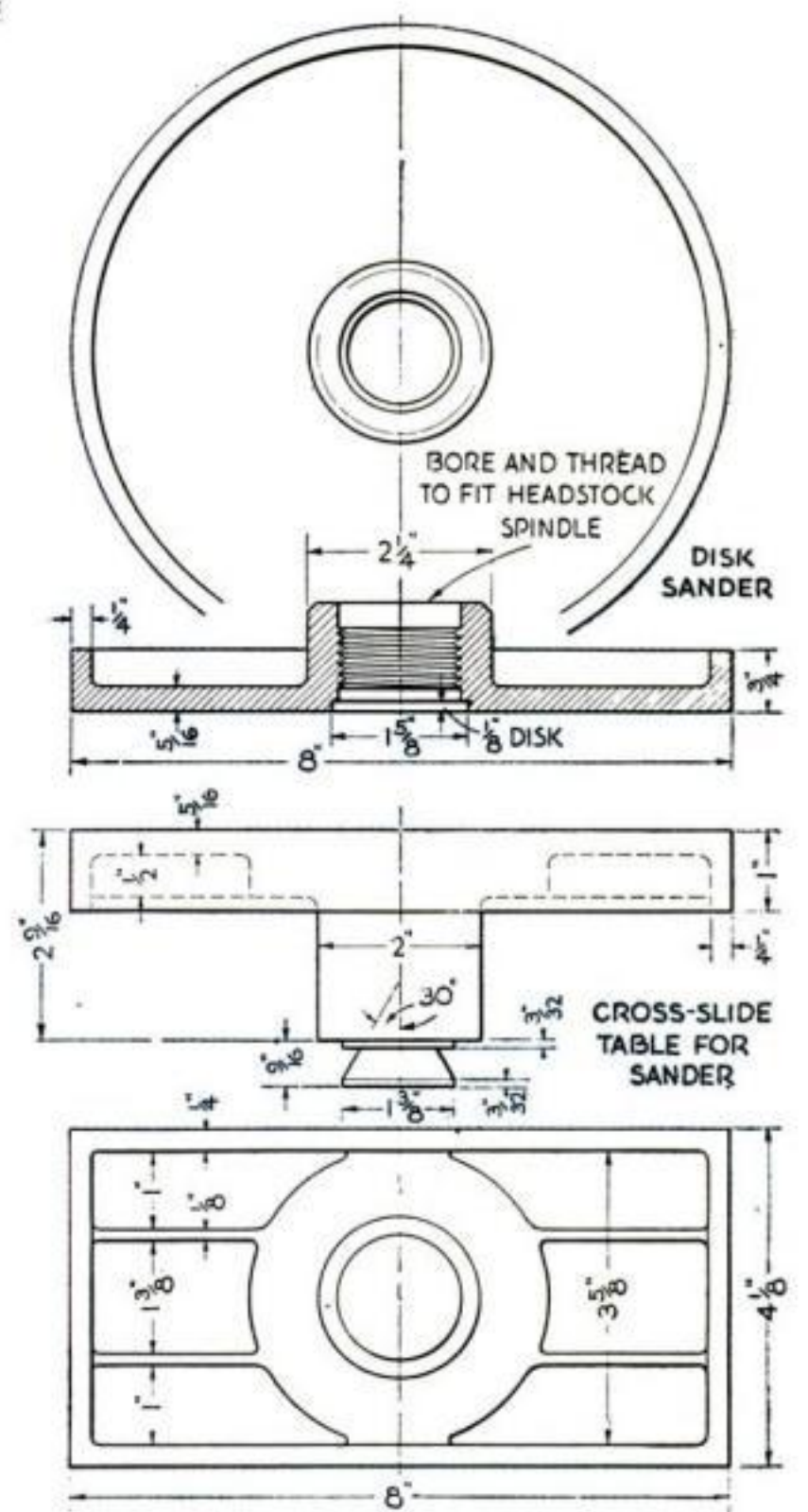
When the castings had been obtained from a local foundry, the machine work was started on the disk. This was firmly gripped in the three-jaw chuck (Fig. 5), and the face turned smooth with a heavy cemented-carbide tool. These carbide tools have nine-tenths the hardness of a diamond and can easily cut through glass-hard scale at high speed. However, by using the lowest back-geared speed, an ordinary tool bit will do the job if it is forced beneath the surface scale into softer metal.

The center hole was next bored (Fig. 6) and threaded to fit the headstock spindle nose. These threads—eight to an inch—and the recess to fit over the shoulder on the spindle were made an exact duplicate of a small faceplate that came with the lathe. Care must be taken to match the parts perfectly.

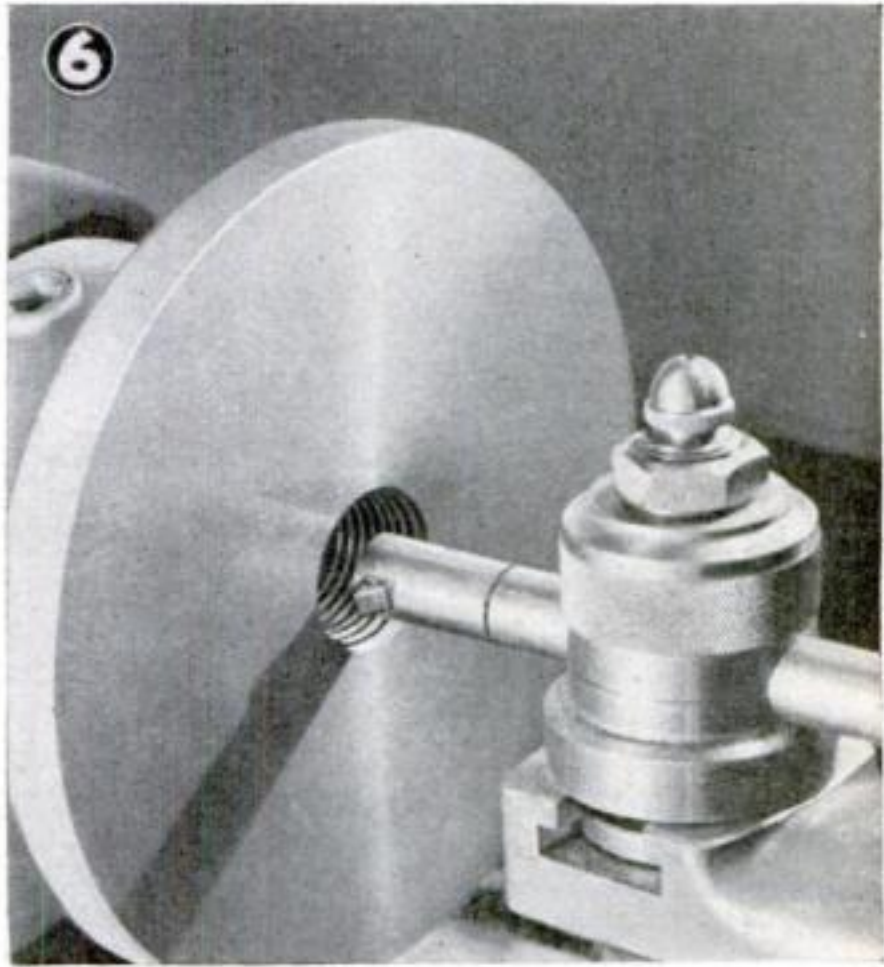
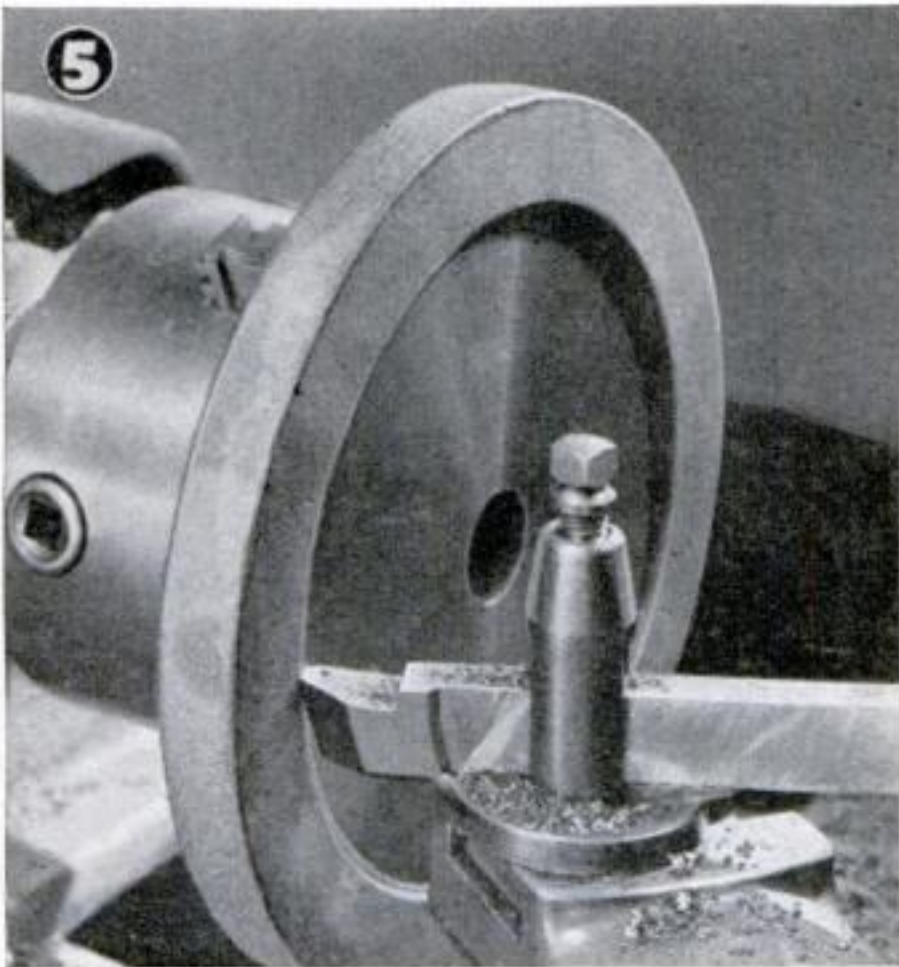
Figure 7 shows a shallow recess being cut to receive a thin steel plug, which was driven in place and faced smooth with the surface of the plate. It was easier to insert this thin disk than to use a casting with a solid front, which would have made cutting the internal threads very difficult, and it would have been impossible to hold the work with the back of the disk facing out.

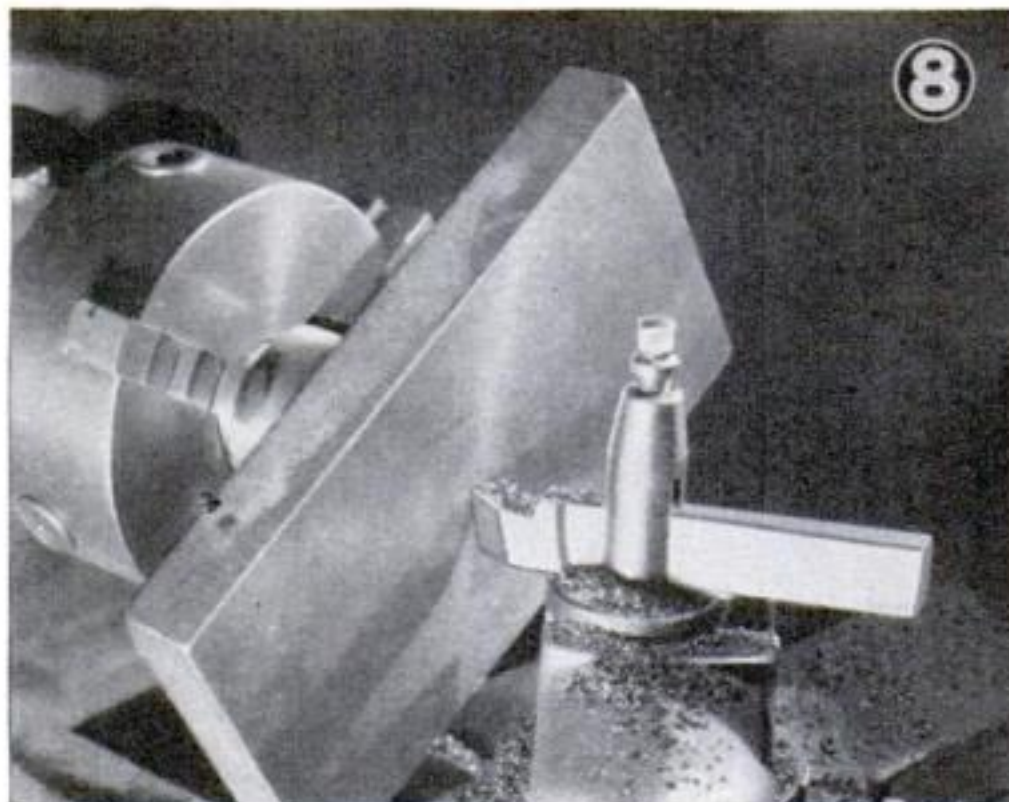
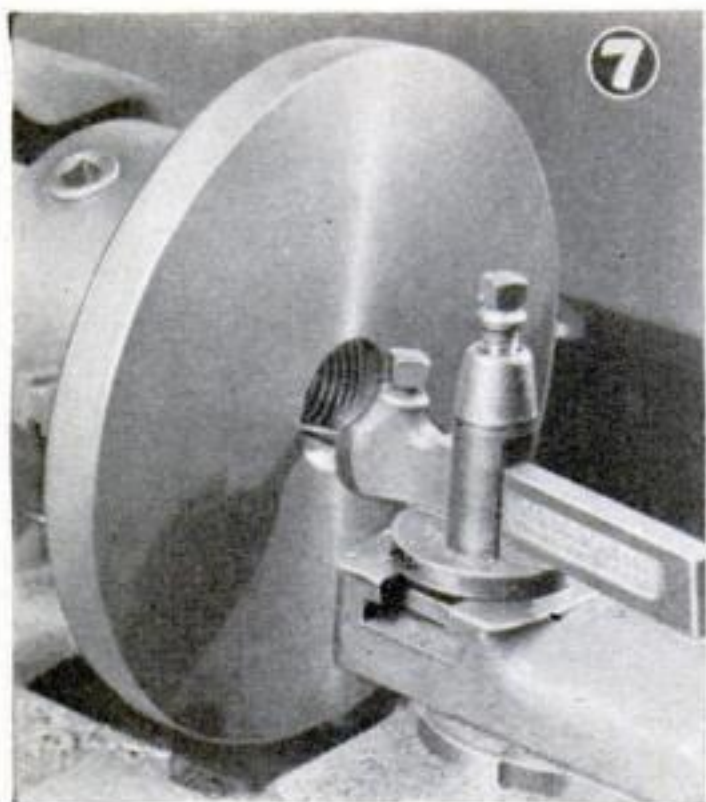
The table top was machined smooth and true while held in the three-jaw chuck as in Fig. 8. The work on the standard was accomplished with the table clipped to the faceplate (Fig. 9). If a faceplate is not at hand, a four-jaw chuck will serve.

For fastening the table to the cross slide,



The dimensions may be adapted to suit any lathe





Left, cutting a shallow recess to receive a thin steel plug for closing the central hole. It is easier to do this than to cut the internal threads in a casting with a solid front. Right, machining the table top



the base should be machined to an exact duplicate of that of the compound rest, which is removed when the table is mounted in its place. The front edge of the table should be machined, and this can be done with the sanding disk, when complete, or by draw-filing. The finished parts are shown in Fig. 2.

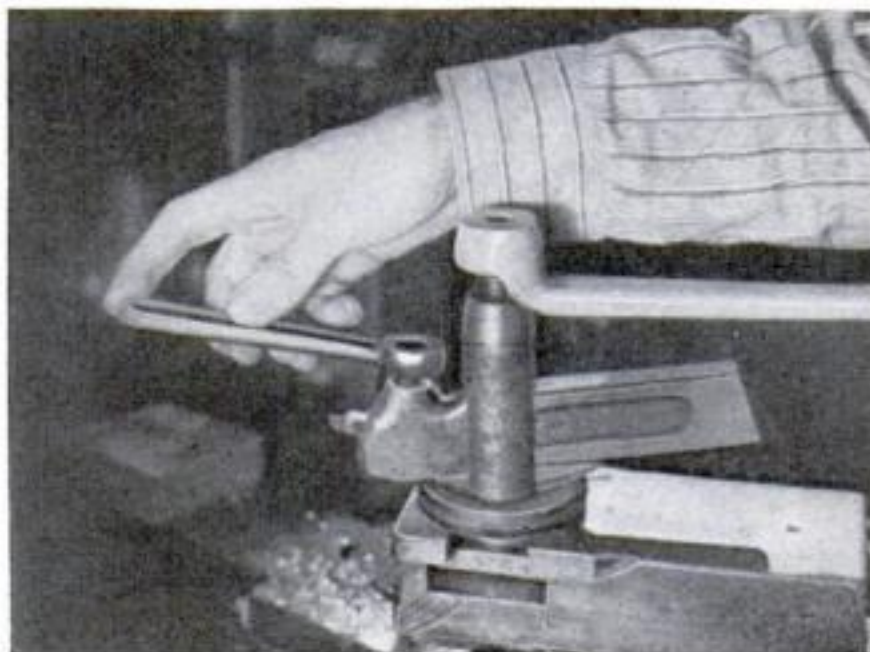
The grade of emery cloth to be used will be determined by the job in hand. In gluing this to the disk, it should be weighted down

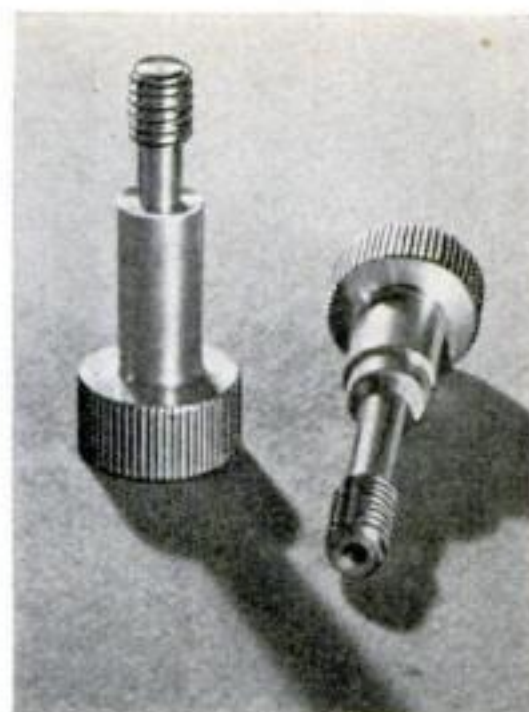
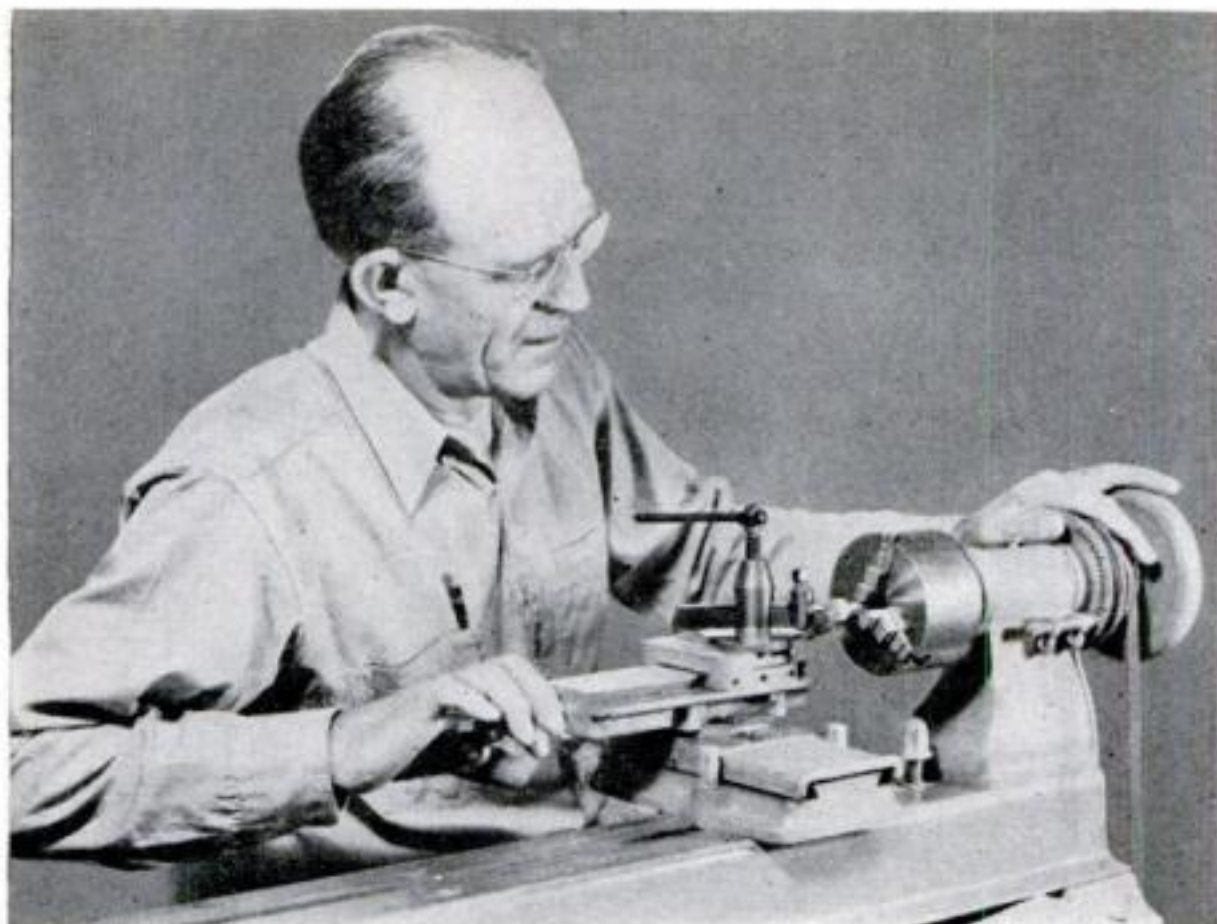
or the disk clamped, face down, to a smooth surface until the glue sets.

For very hard use and longer life, the fiber sanding disks that body and fender repair shops use on their portable sanders will stand up best. The grit on these sanding disks is so hard and so fast cutting it will easily grind the hardest high-speed cutter bits and other highly hardened metals.—C. W. WOODSON.

Extended Handle of Wrench Shields Sharp Lathe Bit

A SHARP turning tool bit left in the tool-post of a lathe is a hazard because the operator's hand or arm may come into accidental contact with it. An effective way of shielding such a bit is to turn the handle of the lock-screw wrench straight out, as shown. Whenever possible, however, lathe tools of this type should be removed entirely and placed in a box or drawer.—W. B.





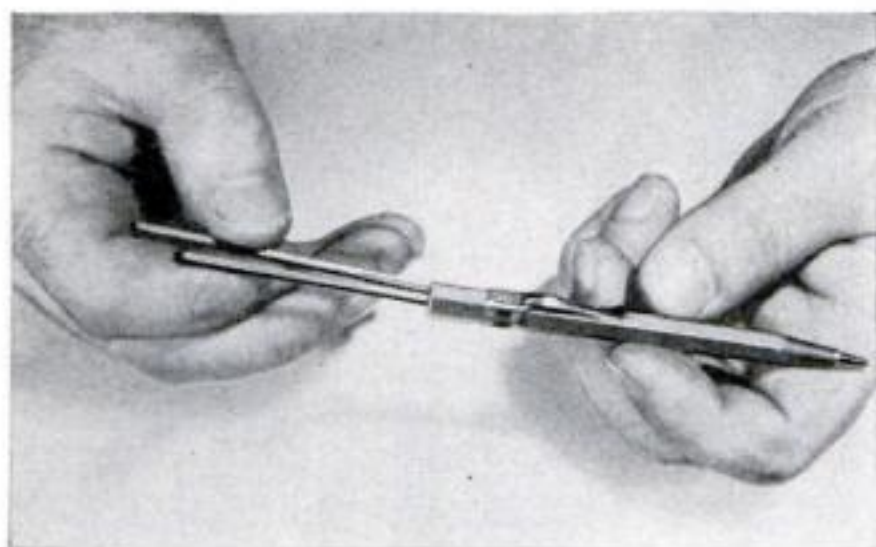
Turned on its side, a spear-pointed tool bit may be used to do straight knurling like that shown in the examples above

Small Brass Parts Knurled Neatly Without Using Special Tools

WHEN no knurling tool is available and one wishes to add an ornamental grip to an otherwise smooth metal turning of brass or other soft metals, try the method illustrated above. It produces neat, clean-cut, parallel knurling.

A spear-pointed tool bit is turned over on its side, and the cuts are made with the use of the cross feed. First use the traverse

feed to advance the tool bit until it jams lightly against the work. Take the sleeve reading, say 30, and slide the bit off the work with the cross feed until it clears. Now advance the bit 5 deg. to 35 and make the first cut. The indexing head is used for spacing the remaining cuts. The two camera tripod screws shown in the smaller photograph were knurled in this manner.—F. H.

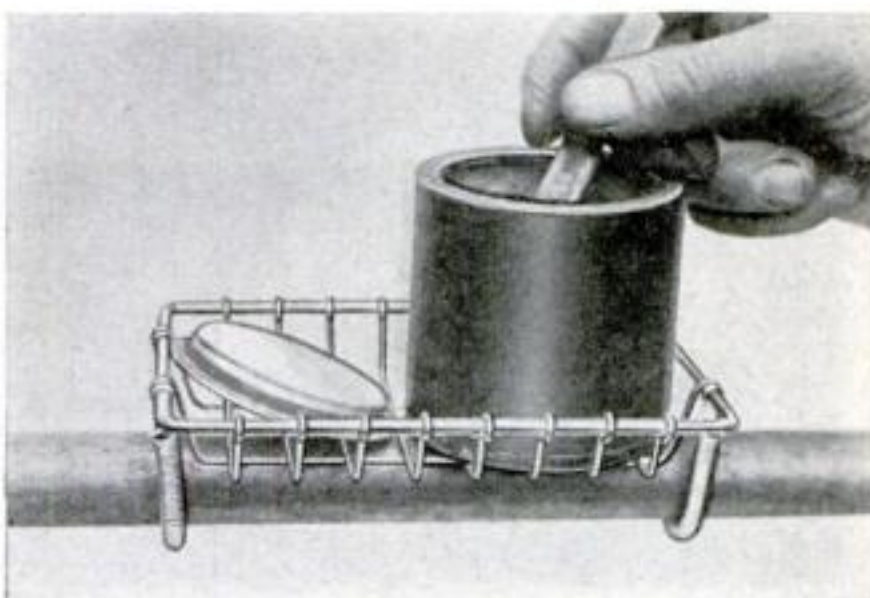


Repairman Carries Tiny Files in an Empty Pencil Barrel

IN ORDER to carry jeweler's files in his pocket so that they would always be at hand for the repair of very delicate recording instruments, one mechanic removed the insides from a cheap mechanical pencil and used it as a holder. A bit of cotton was stuffed into the tapered end so that the file points would not protrude. The same idea can be adapted for other purposes; in fact, old pencil barrels, whether metal or plastic, are always worth saving.—K. M.

Wire Soap Basket Holds Cans While Being Warmed on Pipe

GLUE, wax, plumbago, and other compounds in small cans often have to be kept warm for use in the workshop. If there is a horizontal steam or hot-water pipe in some convenient location, a common wire soap tray may be used to hold a can as shown.



Compounds that have to be kept warm may be placed in a wire tray over a horizontal steam pipe

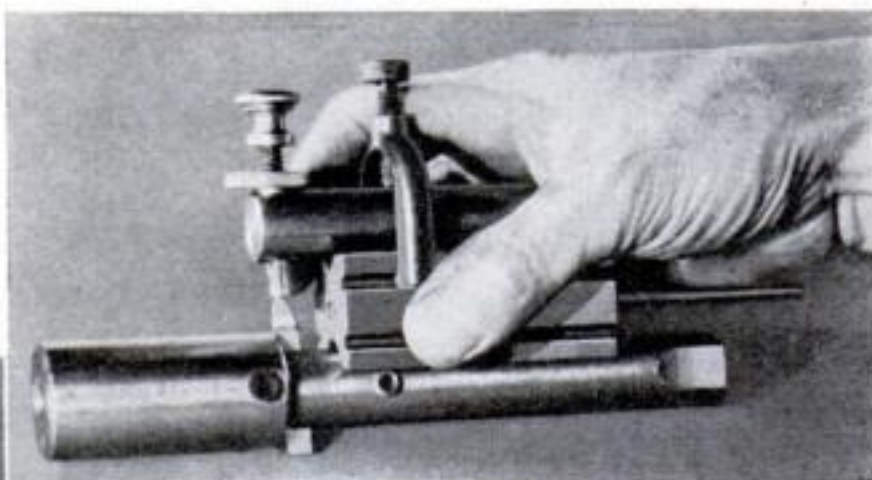
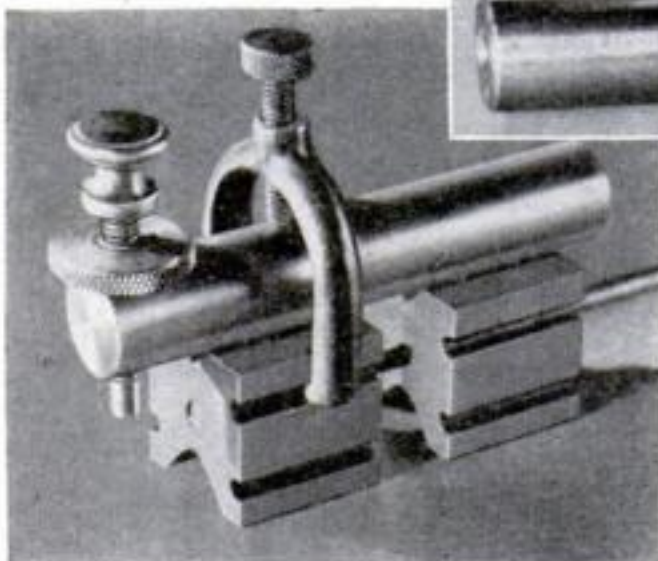


Washer Serves as Substitute for Offset Screw Driver

PROBABLY every mechanic has had to remove or replace a screw in a tight place on some occasion when a right-angle or offset screw driver was not available. In such an emergency an ordinary iron washer makes a good substitute. A center punch or other round object can be inserted in the washer to turn the screw. Surprising force can be exerted if the washer is filed to make a snug fit in the screw slot.—JOHN M. AVERY.

Gauge Gives Accurate Adjustment of Cutter for Boring Holes

THE cut-and-try method of boring holes can be avoided by any machinist who makes this simple boring-bar cutter gauge. It consists of a short steel rod, drilled and tapped to receive a $\frac{1}{4}$ "-28 thumb screw and knurled locking nut. Used in conjunction with ordinary V-blocks, as shown, it enables accurate adjustment of the boring cutter. Gauge blocks or calipers will serve to measure the distance between the bar and the cutter tip. Twice this dimension, plus the diameter of the bar, gives the size of the hole the cutter will bore.—C. W.



Gauge is used on V-blocks to adjust cutter

FOUR-JAW INDEPENDENT CHUCK

[LATHE WORK-7]



TRUING ROUND WORK IN CHUCK



MACHINING OFF-CENTER WORK



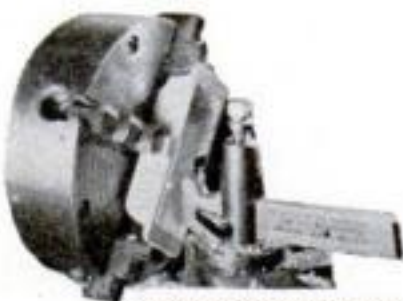
TURNING WORK CHUCKED OFF-CENTER



CHUCKED WITH INSIDE AND OUTSIDE JAWS

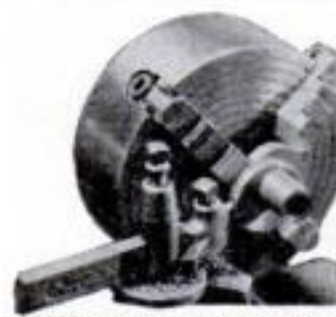


CENTERING RECTANGULAR WORK



CHUCKING ODD-SHAPED WORK

The four-jaw independent lathe chuck is the most practical, most used chuck for general machine-shop work. If the lathe is to have but one chuck, it should be of this type. The jaws are moved separately for holding round, square, or odd-shaped work. They are reversible and can be used for outside or inside work. Always remove the chuck key when it is not in use.

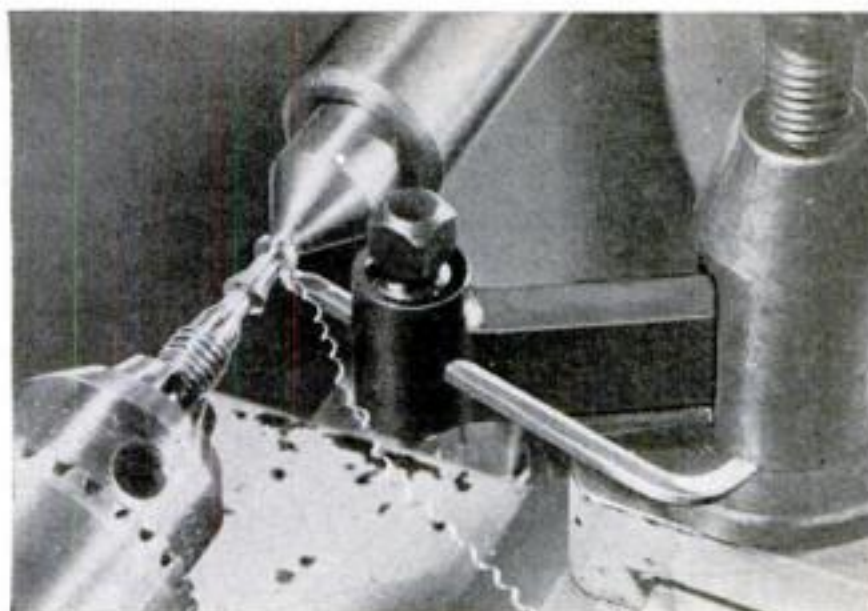


ECCENTRIC CHUCKED OFF-CENTER

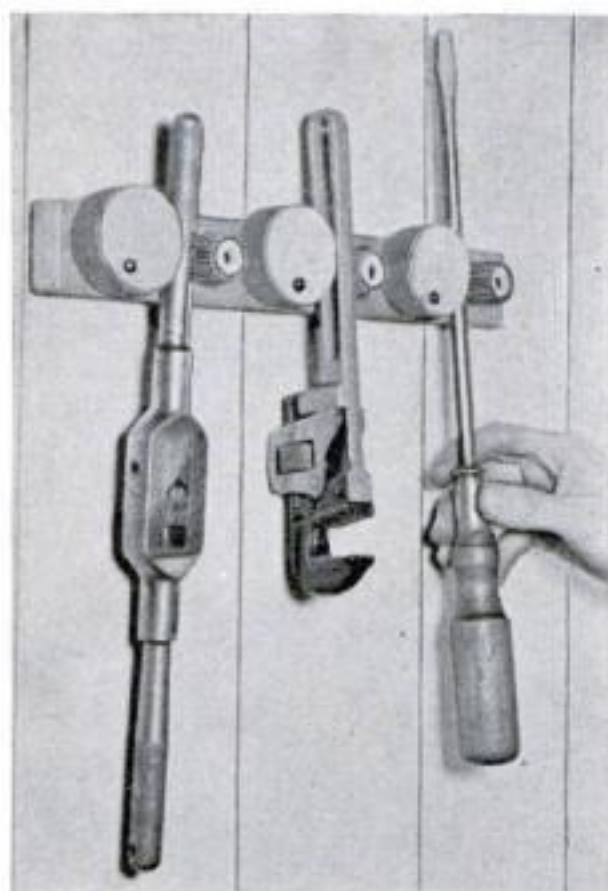
POPULAR SCIENCE MONTHLY SHOP DATA FILE

Special Lathe Tools Ground from Set-Screw Wrenches

DISCARDED safety set-screw wrenches are excellent material for making special lathe tools such as deep-boring bars and internal threading tools. They are hexagon shaped and come in a wide range of sizes. As the temper is just about right, it is necessary only to grind the points to shape. These wrenches may be obtained from any shop using Allen-head screws as there are several packed in each box.—R. H. MCNAIR.

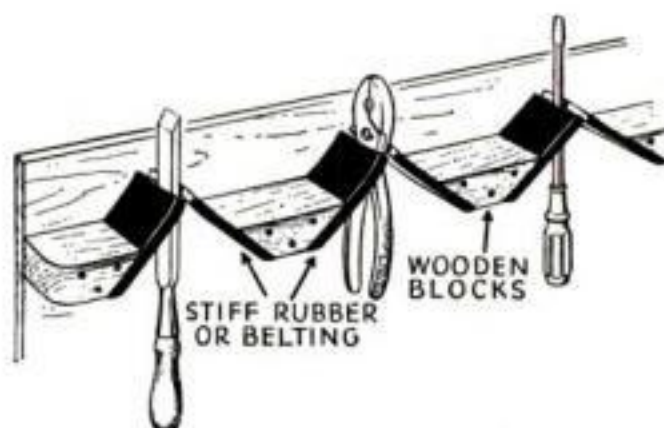


Two Easily Made Wall Racks for Holding Large and Small Tools



LARGE wrenches, screw drivers, and other rod-shaped tools can be hung by means of eccentric disks and fixed pegs as shown in the photograph at the left. The pegs are dowel rods covered with pieces of garden hose and held by screws. The disks, 2" or so in diameter, are cut from $\frac{7}{8}$ " wood, and their edges are covered with electrician's rubber splicing tape. Springs can be added, if desired, to force the disks toward the fixed pegs and provide a better grip.

Scraps of rubber belting, tire casings, or other materials can be nailed to wooden blocks as illustrated in the drawing to form still another type of rack for small tools. This rack is also handy in the kitchen or pantry for holding brooms and mops.



THREE-JAW SCROLL CHUCK

[LATHE WORK—8]

WORK HELD BY CHUCKING LUG



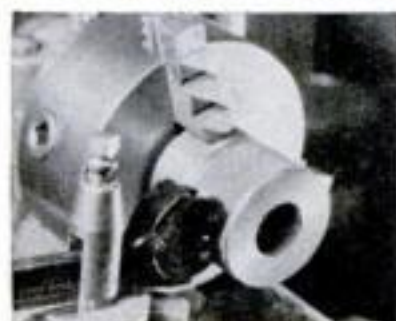
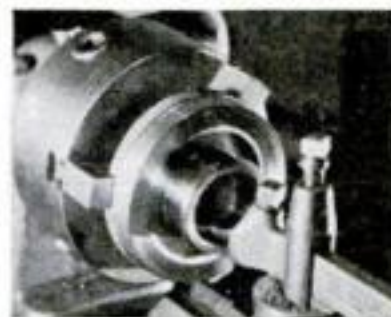
BORING SHORT WORK IN 3-JAW CHUCK



LONG WORK SUPPORTED BY TAILSTOCK



WORK HELD BY OUTSIDE CHUCK JAWS



KNURLING SHORT WORK IN 3-JAW CHUCK

The three-jaw geared scroll chuck is used mainly for holding and quickly truing round work. The jaws move in unison for concentrically chucking cylindrical work. The jaws of the universal chuck cannot be reversed, so two sets of jaws are usually furnished—one set for gripping the outside of work and the other set for gripping in a hole. Both types of jaws are shown.



EXPANDING CHUCK JAWS HOLD WORK IN HOLE

POPULAR SCIENCE MONTHLY SHOP DATA FILE

High-Speed Routing

DONE WITH LATHE AND
CIRCULAR SAW TABLE

By
Howard R. Heydorf

BY COMBINING circular saw and wood-turning lathe, a woodworker can equip himself with a high-speed routing machine that has definite advantages over a drill press or other machines used for this type of work. Because it makes use of the regular saw table with its standard miter gauge and rip fence, this set-up needs only a few simple jigs to adapt it for any work.

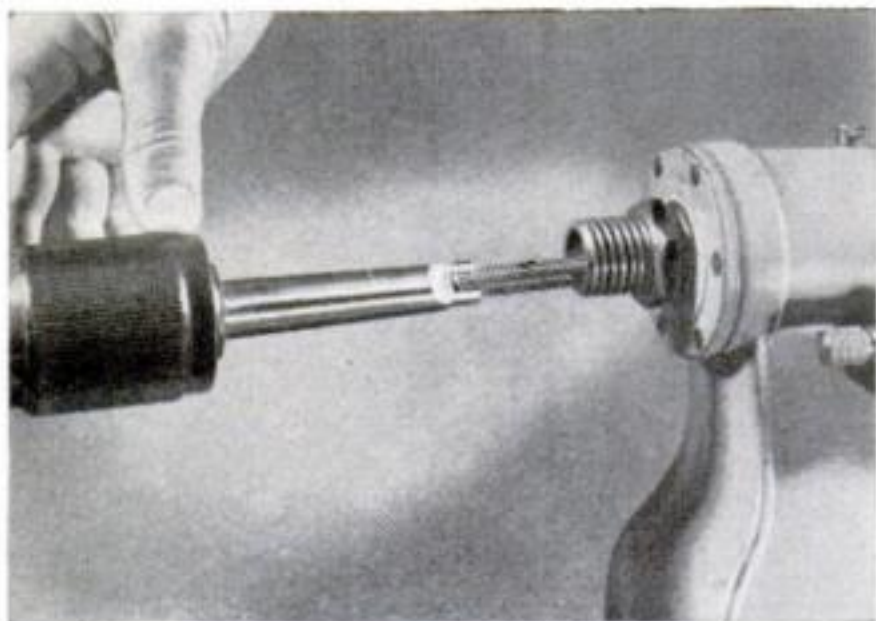
The saw and lathe must, of course, possess certain features. The saw requires a table that can be raised and lowered. The lathe

must have a headstock equipped with roller or ball bearings and of a type that may be reversed upon the lathe bed as shown. Good bearings are required because the spindle must be speeded up to at least 5,000 r.p.m. Higher speeds up to 10,000 r.p.m. are even better because they will eliminate any tendency to feather.

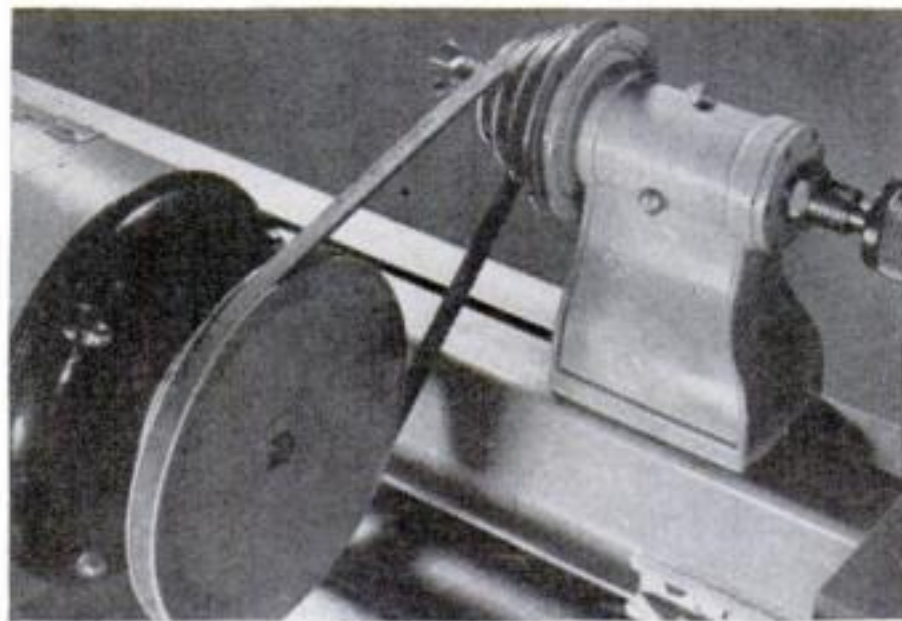
The headstock is reversed upon the bed, and the lathe bed lined up with the center of the saw table. To insure accuracy, the machines must be mounted on a strong bench so there is no chance of movement between the two machines. The lathe bed should be blocked up until the router bit just touches the saw table when the latter is raised to its highest level.

A standard lathe drill chuck is used to hold the router bits. As the vibration will loosen the chuck in its taper, it must be fitted with a threaded rod that passes through the spindle and is held at the other end with a wing nut.

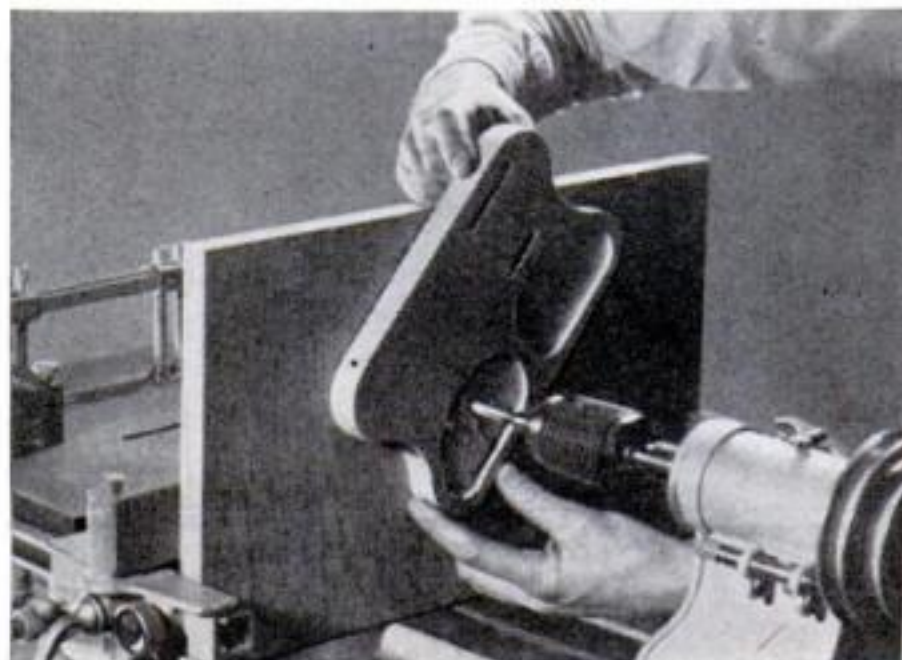
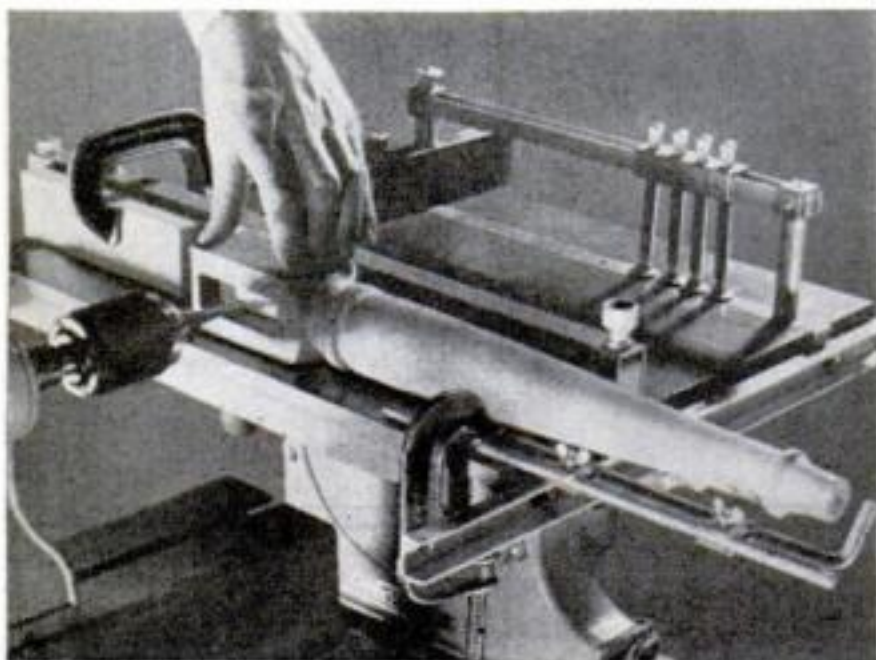
Set-ups for various types of work are illustrated. Deep mortises are best made in a number of cuts. Although not shown, the miter gauge may be used to advantage in cutting mortises in the ends of stock. Tenons may be cut by using the miter gauge and the bit to cut a rabbet on each side.

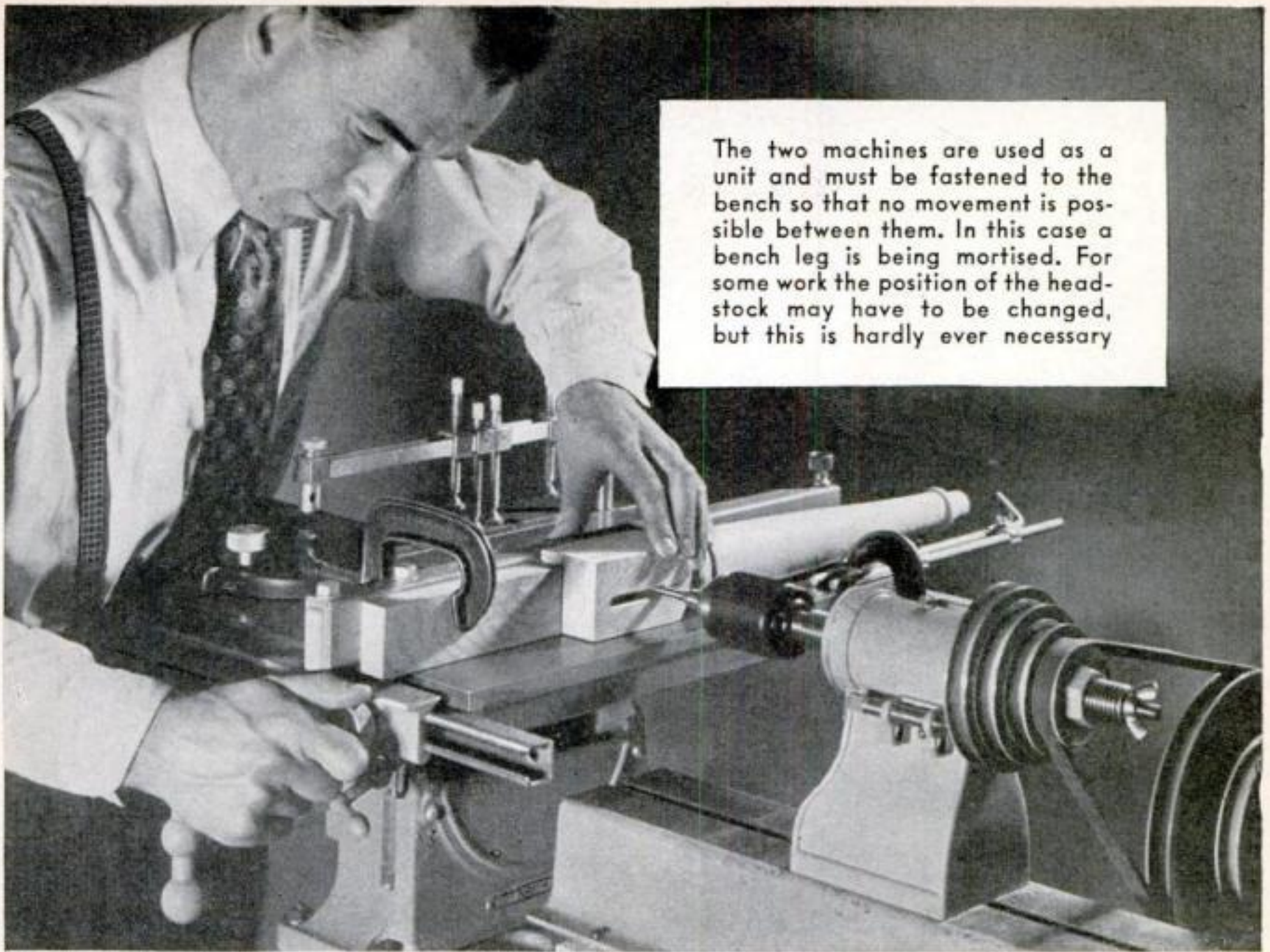


How the threaded rod is attached to the chuck. In some cases it may be screwed into a hole drilled and tapped in the spindle. Below, wide mortises are made by successive cuts. Note use of stop rods

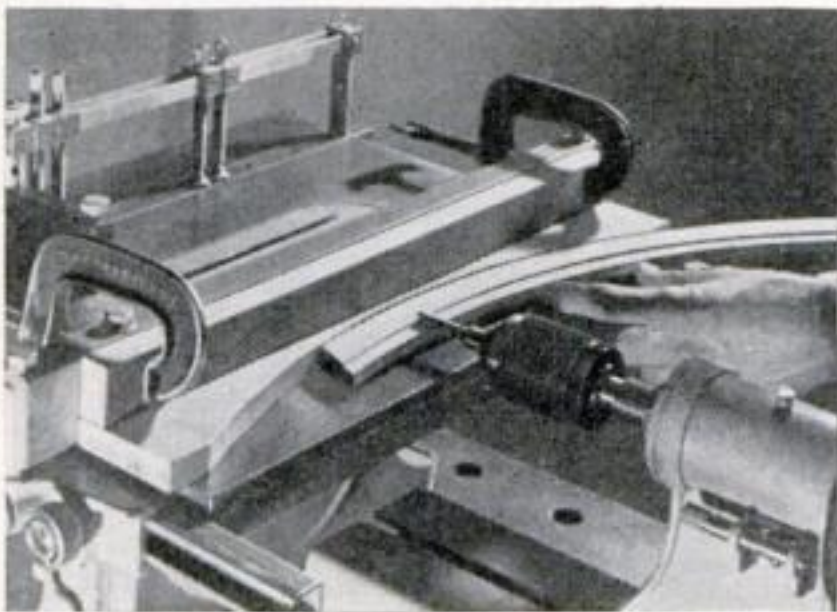


Motor drive for spindle. A wing nut on the threaded rod holds the lathe chuck securely. Below, $\frac{3}{4}$ " plywood is fastened to rip fence for ordinary surface routing. The cuts should not be deeper than $\frac{1}{4}$ "

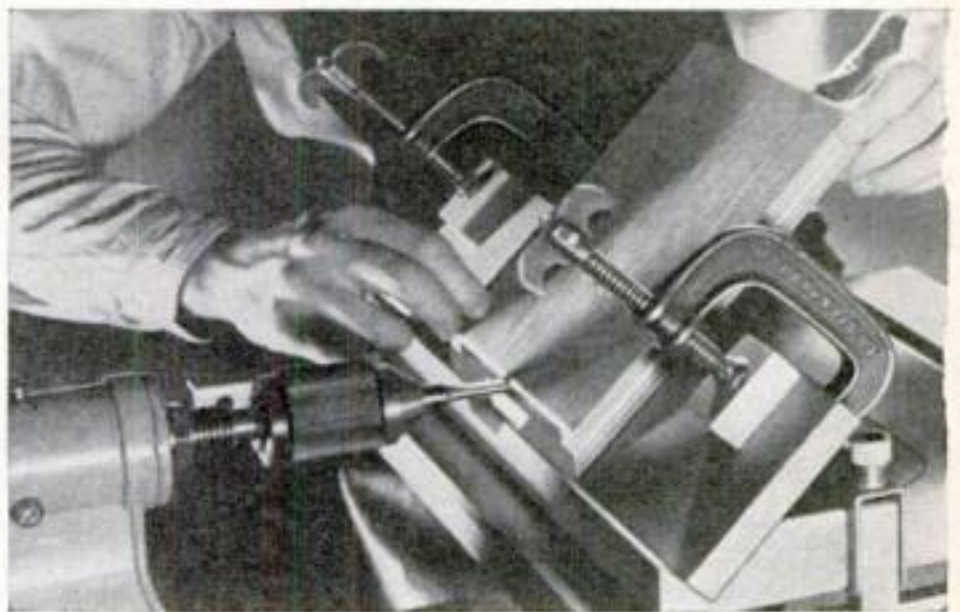




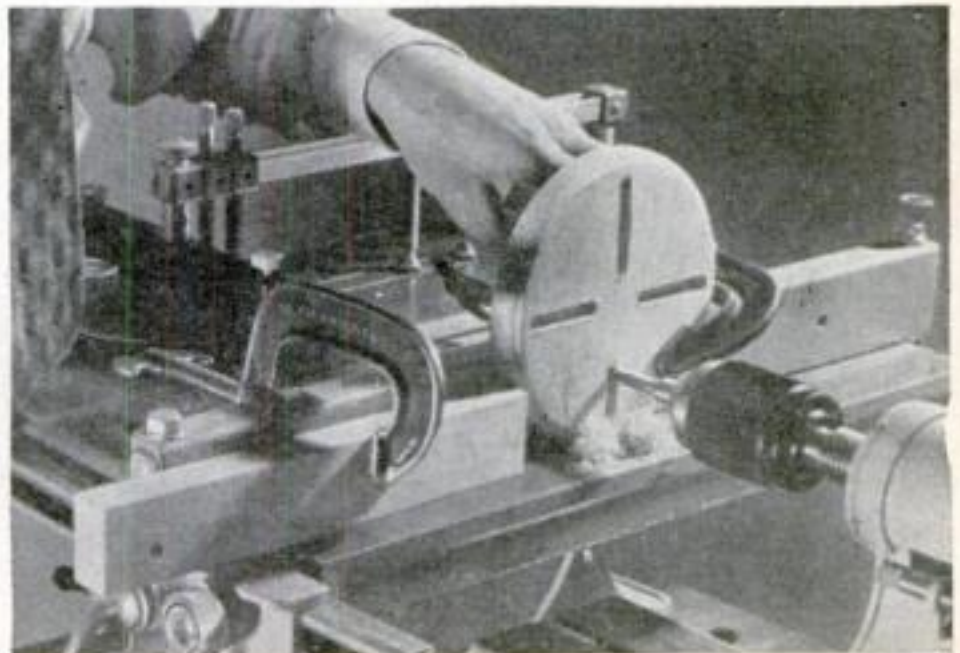
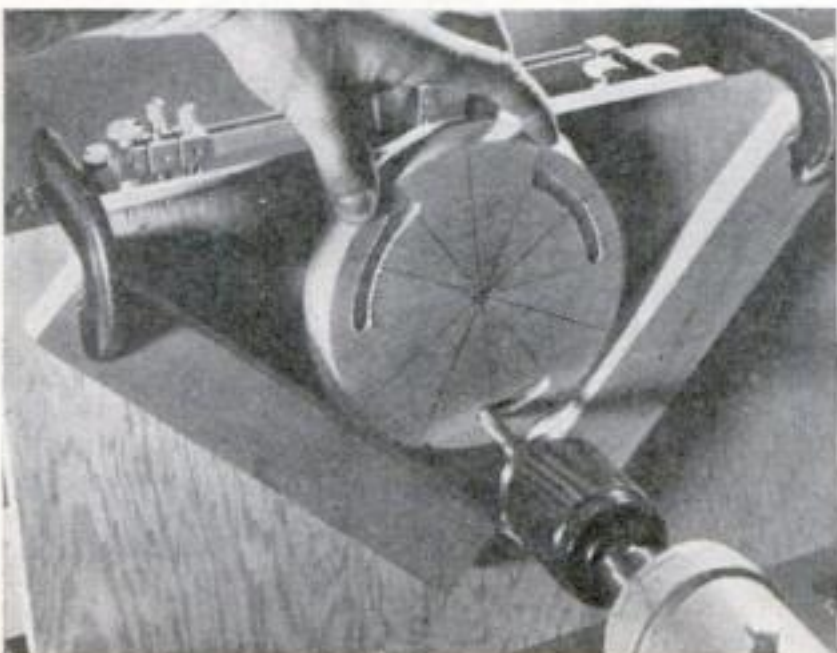
The two machines are used as a unit and must be fastened to the bench so that no movement is possible between them. In this case a bench leg is being mortised. For some work the position of the headstock may have to be changed, but this is hardly ever necessary



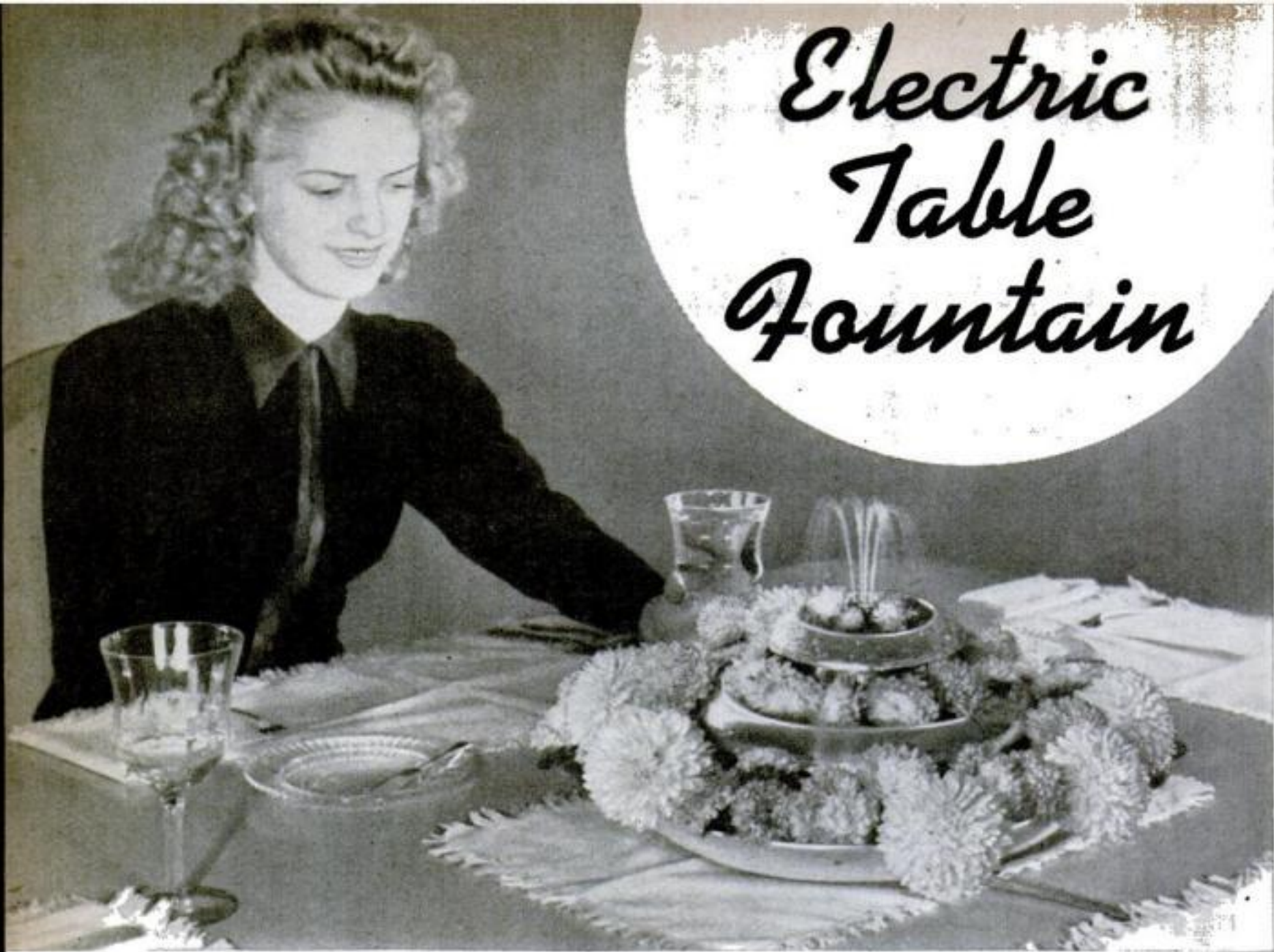
With a suitable guide, the bit serves for grooving or rabbeting curved work. The depth of the rabbet is controlled by the saw-table elevating adjustment. Below, a jig for circular mortises



When mortises must be cut at an angle of 45 degrees, this jig may be used. The rip fence regulates depth of cut. Below, work may be clamped to the rip fence and the elevating mechanism used to feed the cut



Electric Table Fountain



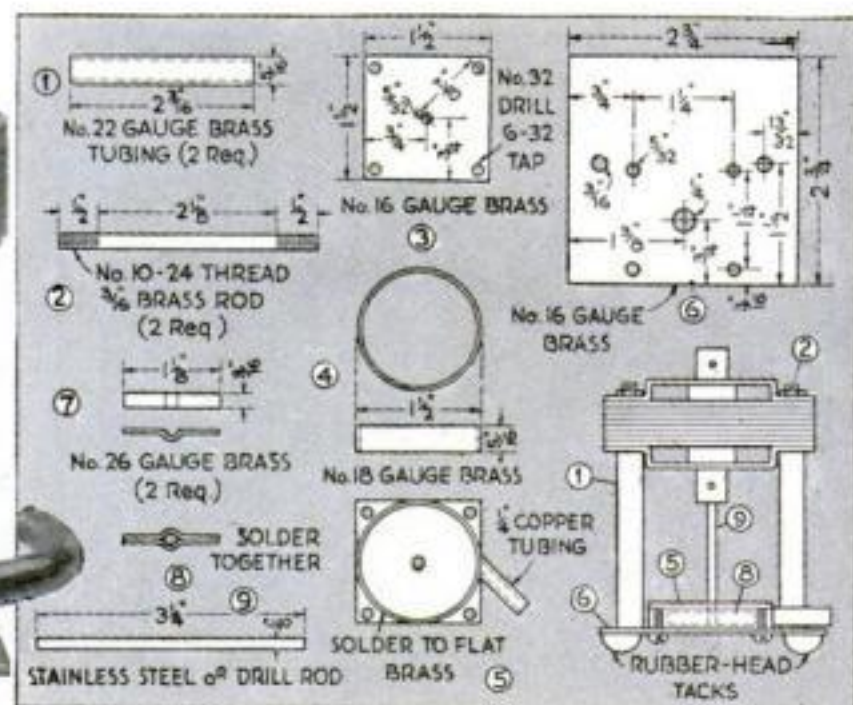
By KENDALL FORD

WHEN filled with flowers, this easily built electric fountain is an attractive centerpiece for the dining- or living-room table. Flowers last much longer than when placed in ordinary containers, and the fountain also serves as a humidifier. A few drops of perfume added to the water will lend a delightful fragrance to a room. By means of a simple adjustment, the spray may be regulated from a small trickle to a height of 6" or 8".

Copper was used in making the fountain illustrated, and the cost of materials was about \$3.50. The pump, which is housed in the center of the fountain, is built around a small 110-volt induction motor costing about \$1.50. The field laminations

of the motor are riveted together. Remove these rivets and redrill the holes with a 3/16" drill so the threaded brass rods (Fig. 2 in the drawings) will pass through the hole. These rods and the tubes shown in Fig. 1 form the motor supports.

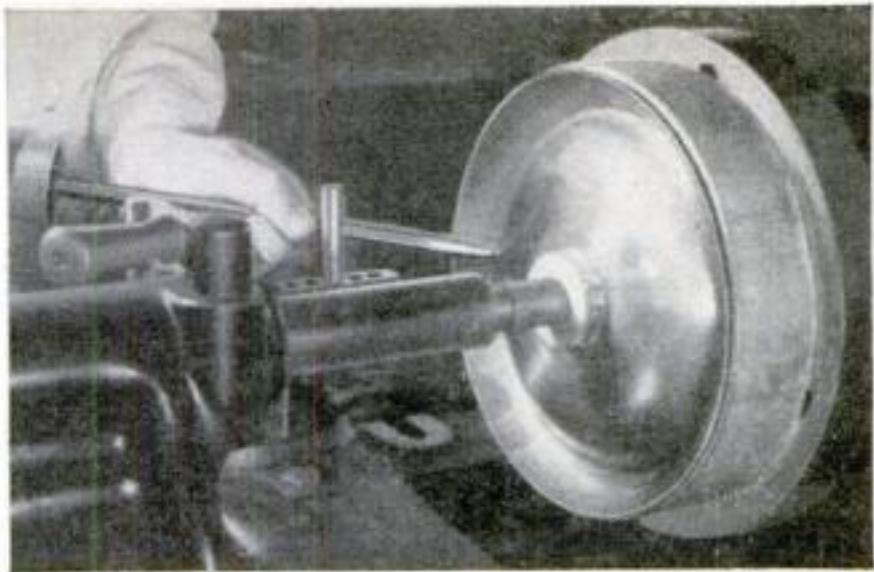
The motor should run in a clockwise direction when viewed from the pump side of the shaft. Since the end bearings are reversible, it is a simple matter to remove the motor armature and turn it end for end if necessary.



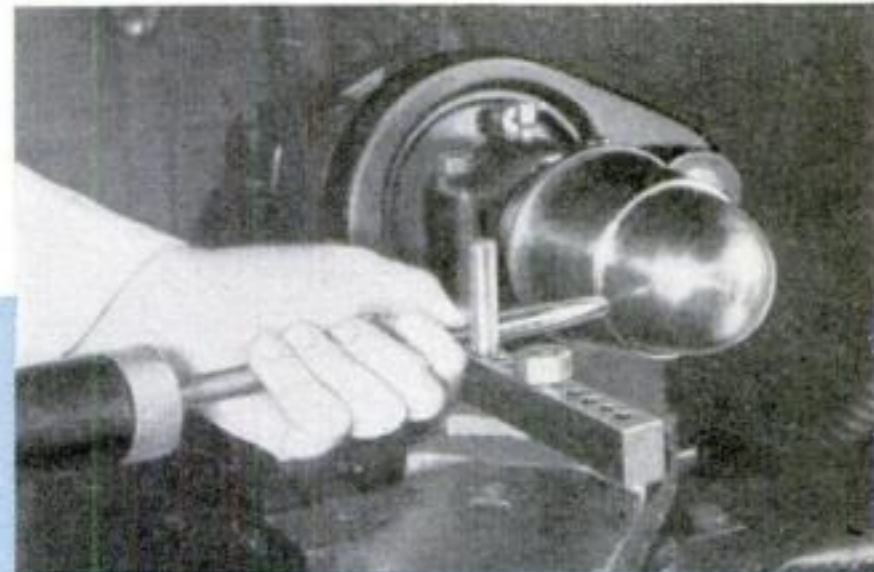
Remove the shaft from the armature and replace with a piece of stainless steel (Fig. 9), or steel rod may be used if first copper-plated to prevent rust. A brass rod could also be used if extreme care were taken not to bend it.

The pump housing consists of 18-gauge brass tubing (Fig. 4), to which the top plate (Fig. 3) has been soldered. A piece of $\frac{1}{4}$ " copper or brass tubing, 1" long, should be inserted into the side of the pump housing (Fig. 5) and soldered at an angle of approximately 45-deg.

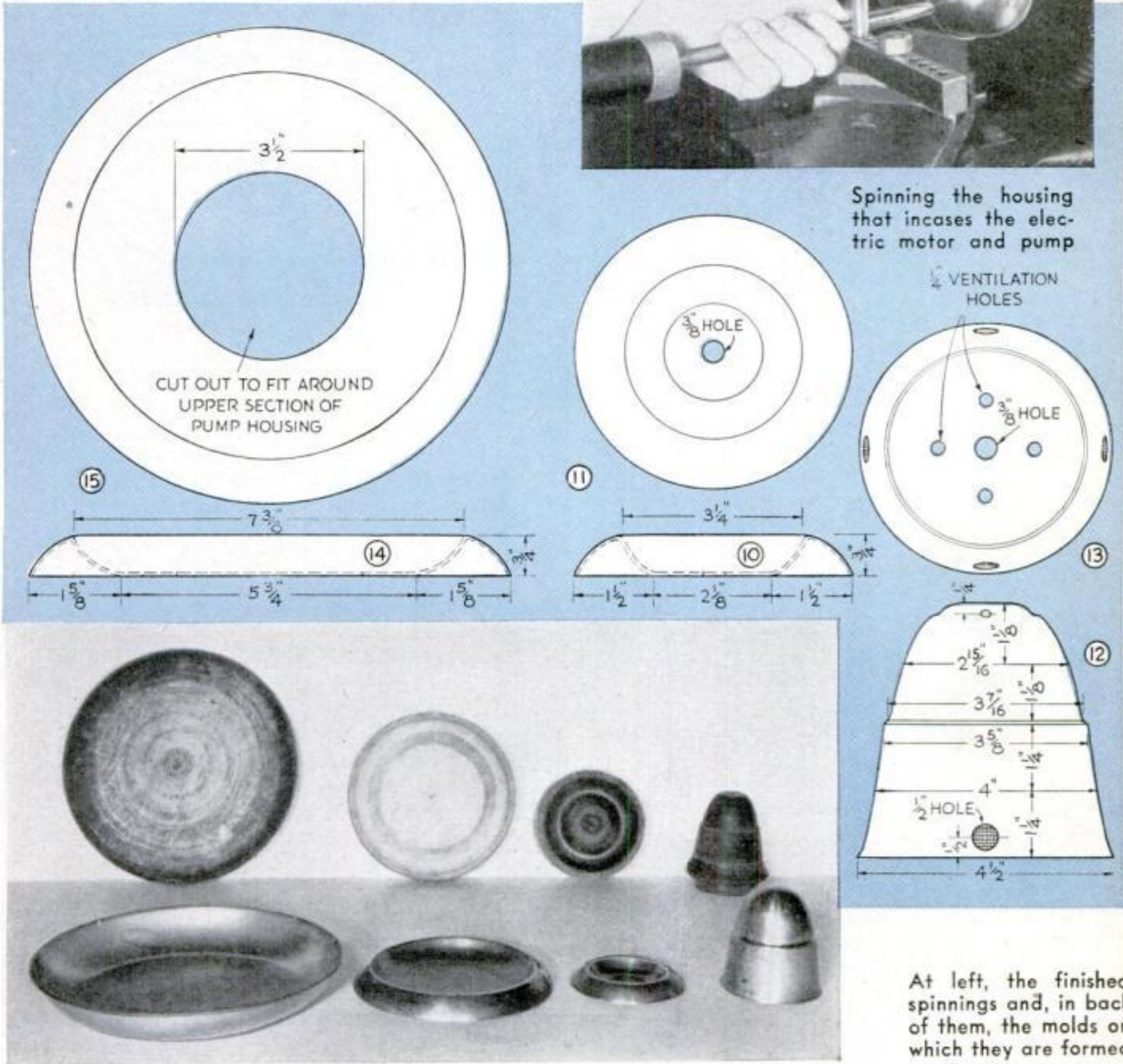
The pump vane consists of two pieces of 26-gauge brass (Fig. 7), soldered together as shown in Fig. 8. Before the vane is soldered in place, the pump housing should be slipped on the motor shaft. The soldering may be facilitated by clamping a small U-shaped scrap of metal over the ends of the vane. Be sure to



Each copper section is formed over a wooden mold



Spinning the housing that incases the electric motor and pump

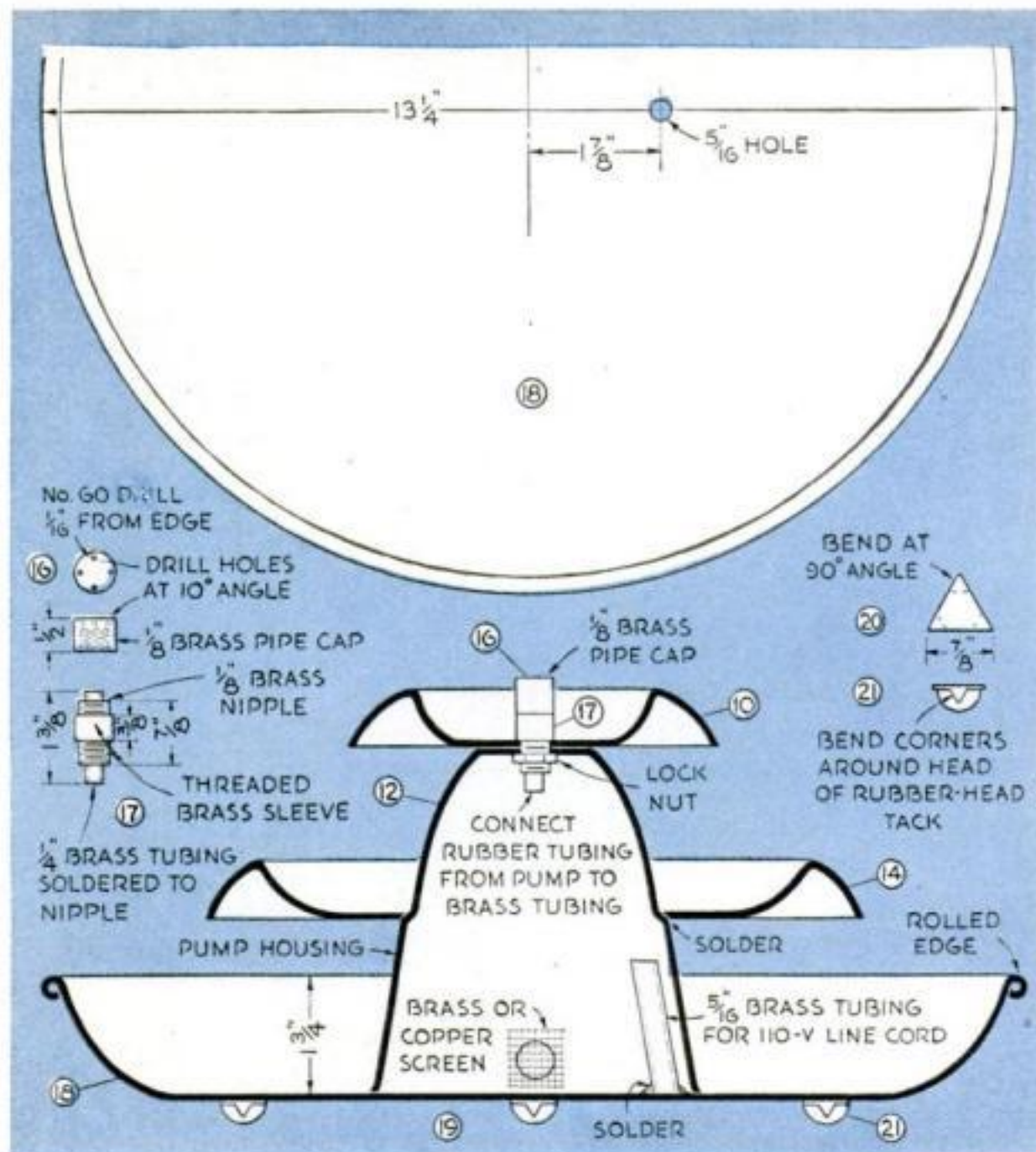


At left, the finished spinings and, in back of them, the molds on which they are formed

get the vane at right angles to the shaft.

When the vane is in place, secure the bottom plate (Fig. 6) to the motor by means of the brass rods (Fig. 2), brass tubing (Fig. 1), and 10-24 brass nuts. Fasten the pump housing to the bottom plate with four 6-32 roundhead brass machine screws, $\frac{1}{2}$ " long. Before tightening the screws, see that the motor shaft clears the hole in the housing all the way around. Shellac or paint placed around the edge of the pump housing before it is fastened to the bottom plate will assure a water-tight joint. Attach a rubber-head tack at each corner of the bottom plate so that the pump intake hole will be clear.

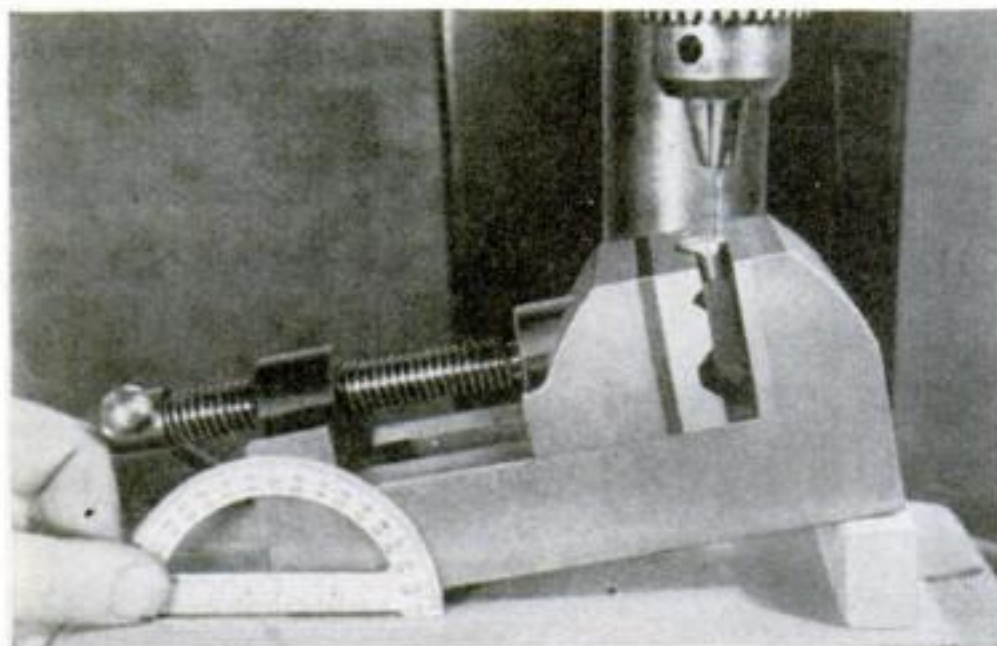
The fountain is of spun copper, aluminum, or brass. It consists of the top plate (Fig. 10), the motor and pump housing (Fig. 12), the middle plate (Fig. 14), and the bottom bowl (Fig. 18). The size of the blank disks for spinning these parts are respectively 7", 10", $10\frac{1}{2}$ ", and 14". The assembly that secures the top plate to the pump housing is shown in Fig. 17. The



brass pipe cap at the top of the fountain, which controls the spray, is screwed on the upper threaded section of the assembly (Fig. 17). The $\frac{1}{4}$ " brass tubing should extend far enough beyond the brass nipple so that it touches the inside top of the brass cap before it rests against the threaded brass sleeve. By turning the cap to the right or left, the amount of water flowing through the small holes in the pipe cap may be regulated.

The holes in the pipe cap should be laid out with extreme care and be drilled with a No. 60 drill at approximately 10 deg. If a drill-press vise is used, the proper angle may be obtained by blocking up one end of the vise.

Before the top plate and pump housing are fastened together, the middle plate, from which a center hole large enough to fit over the housing has been cut, should be soldered to the housing. The joint should be water-tight, and all soldering should be done underneath. When assembling the top plate and the pump



Holes in the pipe cap must be laid out with extreme care and drilled with a No. 60 drill at approximately 10 deg.

housing, shellac or paint should be spread on the fittings.

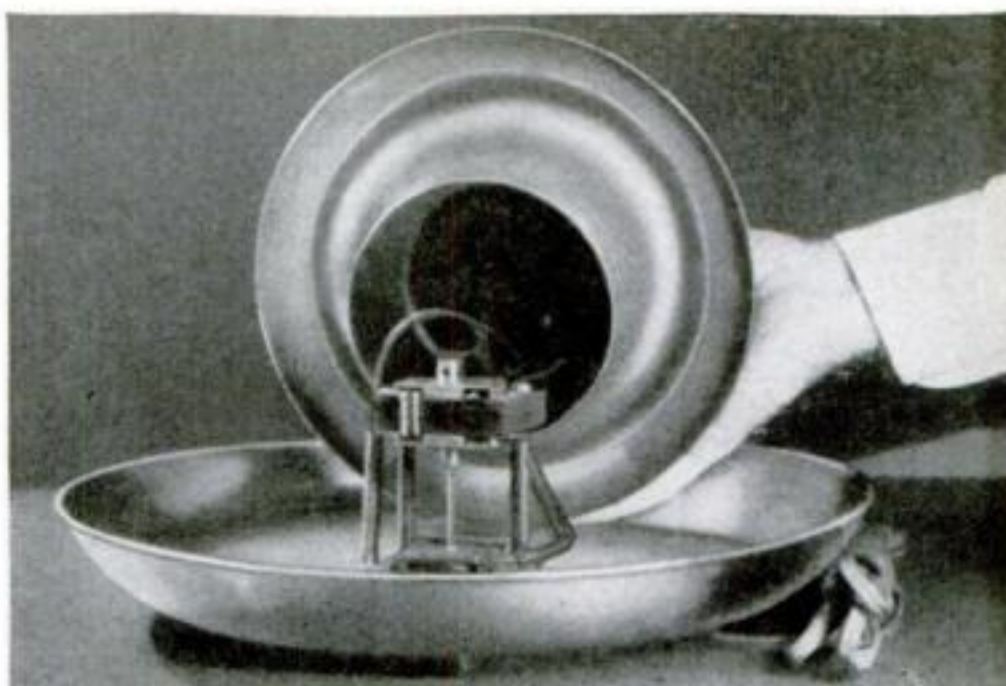
A 5/16" hole should be drilled in the bottom bowl, in which a piece of brass tubing is soldered. This serves to conduct the 110-volt line cord to the motor.

The supports for the fountain consist of rubber-head tacks from which the tack shank has been removed. Four triangular pieces of metal are soldered at their centers to the bottom of the bottom bowl, after which the ends are bent around the rubber tack heads as shown in Fig. 21.

Place the pump in the center of the fountain, pass the line cord through the brass tubing, and connect it to the motor terminals. Slip a piece of 1/4" rubber tubing, 6" long, over the end of the outlet pipe on the pump; then reach into the pump housing and attach the other end of the rubber tubing to the brass tubing that extends from the spray nozzle. Place the housing over the pump, taking care not to kink the hose. This may be accomplished by rotating the housing a quarter turn to take up the slack in the rubber tubing.

Fill the bottom bowl with water to within 1/2" of the top and connect the line cord to 110 to 120 volts, A. C., 50 or 60 cycles. Adjust the spray nozzle to the desired height by rotating the pipe cap.

The finish of the fountain is left to the builder. This may range from a highly polished surface to a variety of colors, depend-



Motor and pump in place with housing removed. Note line cord which enters through brass tubing soldered to bottom

ing upon the metal used in making the spinings.

Beyond an occasional oiling in the holes provided on the motor and cleaning the screen and spray nozzle, the fountain should provide years of care-free service. An additional note of color may be obtained by adding cake coloring to the water.

Tape Renews Grip of Clamp-on Lamp

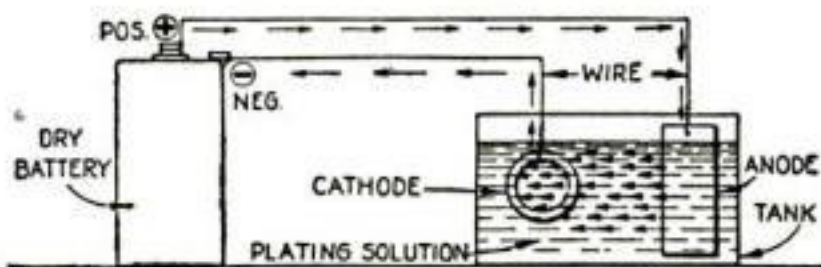
IF THE rubber tubing that covers the jaws of a clamp-on photographic lamp becomes hard, splits open, and falls off, wind a strip of white adhesive tape around the clamp. It will grip as it did when new.

ELECTROPLATING, PART 1

[ELECTRICAL]

In electroplating, a large piece of the plating metal (copper, nickel, silver, etc.) is attached to the positive wire. This is called the *anode*. Suitable chemicals are dissolved in the water to form the *electrolyte*, or plating solution. The article to be plated, called the *work*, is attached

to the negative wire. Electricity passing through the positive wire into the electrolyte carries with it atoms of the anode metal; as the electricity continues on its circuit and leaves the electrolyte, it deposits the anode metal in an even film on the work, or *cathode* as it is technically called. This is the process of *electroplating*, whether it is done on a small or large scale. The drawing, at left, shows by means of arrows how the process of *electroplating* is carried out.

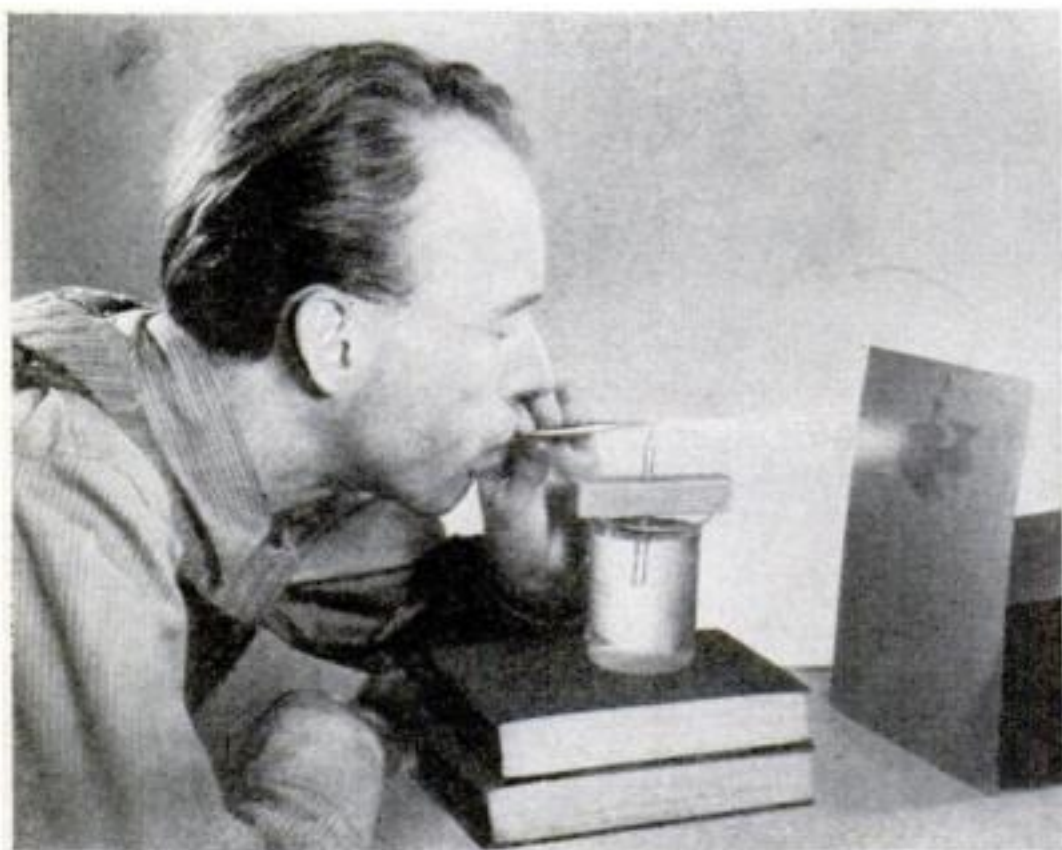


POPULAR SCIENCE MONTHLY SHOP DATA FILE

Science Stunts

THE more you know about how household appliances work, the more you will be able to use them to the best advantage. And to anyone of normal curiosity, it is an added satisfaction to understand the principles of everyday objects about him. So here are five little experiments that demonstrate the workings of an atomizer or spray gun, a sink trap, an ice box, a pressure cooker, and a fireless cooker. They require only the simplest of apparatus, such as

every home-science enthusiast will want to have at his disposal—a Bunsen burner, a flask, a beaker, a funnel, and a laboratory stand. Any scientific supply house can provide this relatively inexpensive equipment, or a resourceful experimenter can improvise substitutes. For the benefit of those not already in the know, glass tubing is easily bent to any desired shape—as at lower left—after rotating the tubing in a flame until soft. An expert would have produced smoother curves in the S-shaped tube, but this one works just as well for the purpose of the experiment.



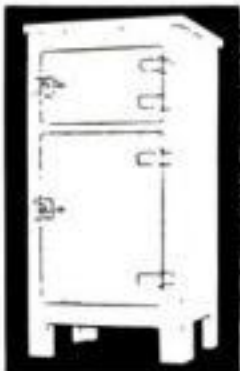
ATOMIZER AND SPRAY GUN. Remove the bulbs from two medicine droppers. Mount one dropper upright, with its large end dipping into water as shown. Blow across its pointed tip with the tip of the second dropper. Water will rise in the first dropper and spray from the tip, as the cross current draws air out of the vertical tube, leaving a partial vacuum within. Outside atmospheric pressure forces water up into the tube, and out the tip, where the passing air stream breaks it up into a spray of fine droplets. For comparison, examine a regular atomizer or spray gun.



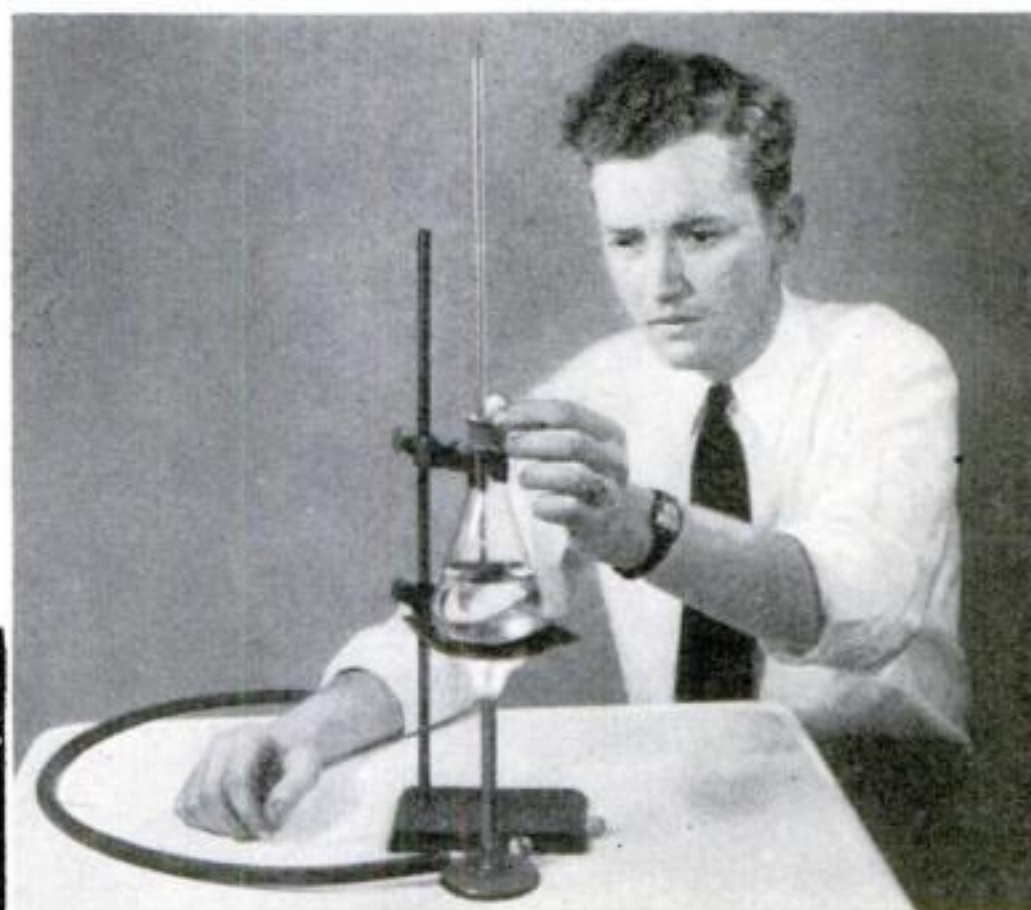
HOW SINK TRAPS WORK. Connect rubber and glass tubing to a funnel as shown. The funnel represents the sink; and the U-shaped tube, the drain-pipe trap. Pour water into the "sink," and most of it will go over the second bend and down the waste pipe. Some remains in the trap, however. In an actual installation, this forms an air seal that prevents fumes from coming up through the waste pipe and sink. The upper part of the T tube corresponds to the vent running to the roof, which prevents downward suction from pulling the water out of the trap. In the illustration, the water is colored so that it will show up more clearly.



SAVING ICE SPOILS FOOD. Users of non-mechanical ice boxes will certainly save ice by wrapping the block in paper or cloth. But the food will spoil. What keeps the ice-box cool is not so much the coldness of the ice, as the heat absorbed by the ice in melting. To show this, punch holes in the cover and bottom of two similar cans. Wrap a small cube of ice in paper and place it in one can; put an unwrapped cube in the other. After a few minutes, a thermometer will show that the temperature within the can holding the unwrapped ice is considerably lower than that of the other. The upper hole admits the thermometer, and the lower is for drainage.



PRESSURE COOKER. Foods may be prepared more quickly in a pressure cooker than in an open pot, because the first gets hotter. Put water in a flask and fit it with a two-hole stopper. Through one hole, insert a thermometer, and boil the water. The thermometer will register 212 degrees F., the normal boiling point. Now cover the second hole with a small marble, confining the steam. You will see the thermometer go up, as the pressure in the flask rises. A heavier marble gives a still higher reading before it is blown off. In a real pressure cooker, a safety valve takes the place of the marble.

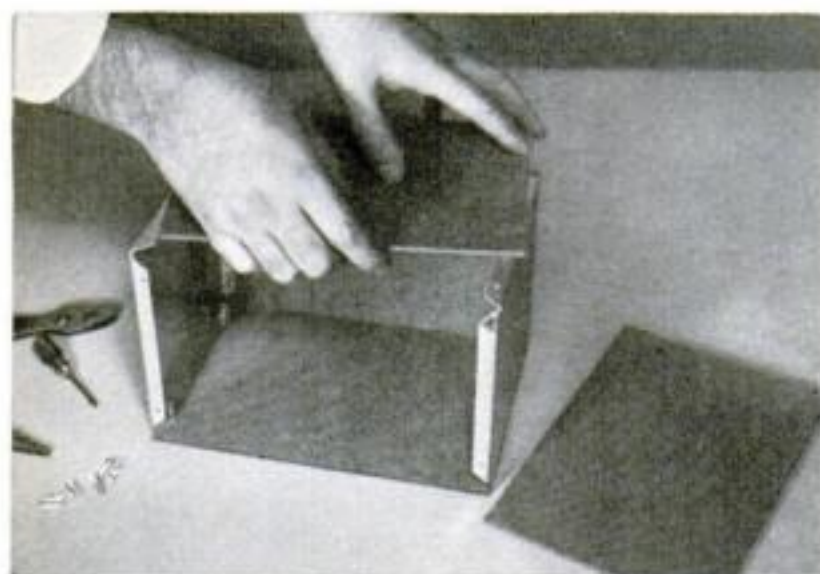


FIRELESS COOKER. The magic of the fireless cooker, in which heated plates of iron or soapstone keep food simmering for hours, is the heat-retaining property of good insulation. Line a large can with cotton. Then insert a smaller can, filled with hot water. Put similar lining over it, and cover the large can. After fifteen or twenty minutes, you will find that the water is nearly as hot as when you put it in. The lining around it prevented the escape of its heat.



RADIO IDEAS

ADJUSTABLE GRID CAPS now available will fit either the small grid tips of metal tubes or the larger tips found on many of the older glass tubes. The spring-brass clip is completely insulated as shown in the photograph above, so that the fingers cannot touch the tube. It may be purchased unwired, or with a 15-inch rubber-covered stranded wire lead.

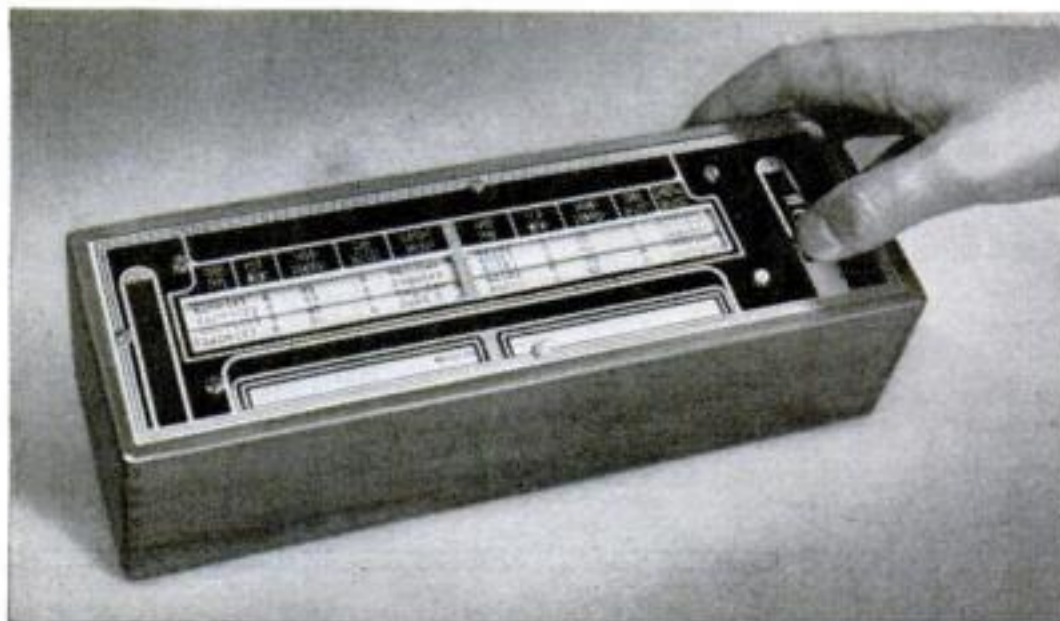


KNOCK-DOWN CABINET KIT. This item is extremely handy for the radio fan who likes to experiment with new circuits. It consists of four composition panels and two aluminum end panels that form a cabinet nine inches long and six inches square, which can be used in any position. It may be cut down to fit smaller assemblies, and can be re-used by buying new panels to replace used ones. Its light weight makes it suitable for portable outfits.



FILING QSL CARDS, the notices which amateur radio operators exchange to verify radio contacts, is made easier by a specially designed loose-leaf album. It should appeal to the ham who has long wanted to take his QSL's from their traditional filing place on the walls and give his shack a neater and more business like appearance. The album is sold with 50 pages, each holding four cards and provided with stub spacers to prevent the book from bulging. Finished in a red, grained material, it is supplied with the amateur's call letters embossed on the cover.

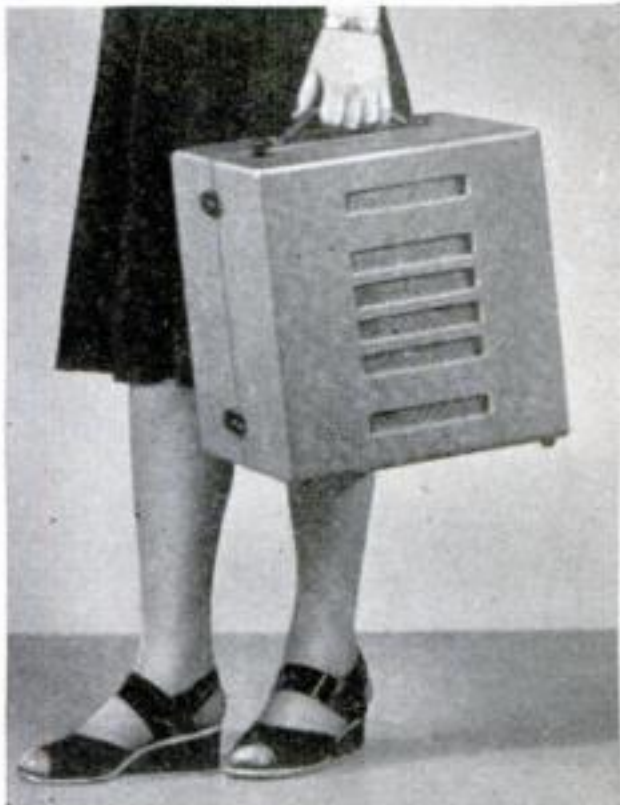
TUBE TESTERS can be modernized with a roll-type tube chart now available to replace the old separate chart sheets. The new chart, operated by a knurled knob at the side of the container, moves beneath a window on which a hair line is engraved to guide the eyes across the row of control-setting figures. The unit is housed in a hardwood case. Additional charts will be made to fit the frame when new tubes make changes necessary.



A PORTABLE ELECTRIC PHONOGRAPH now on the market is fitted with a detachable speaker. For carrying, the speaker forms the top cover of the cabinet and is held in place with snap locks. The phonograph may be used with the speaker in this position, or with it unhooked and hung on a wall or other surface as shown. A crystal

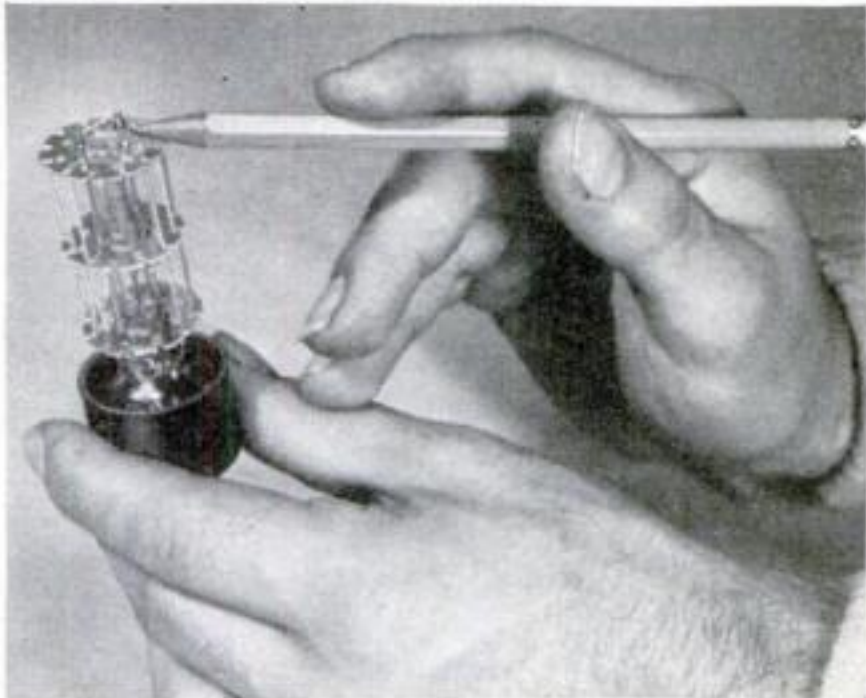
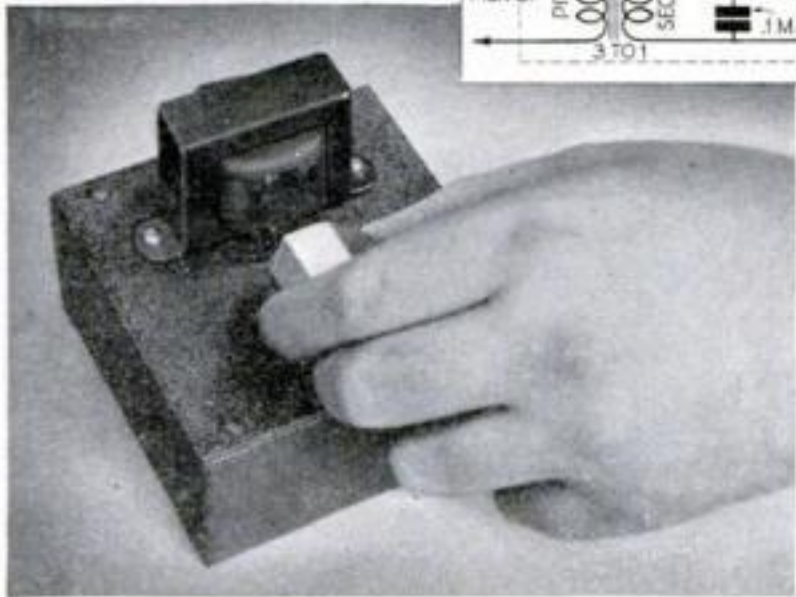
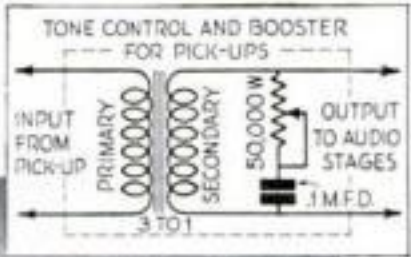
pick-up is used, the output being fed through a built-in three-tube amplifier. For those who wish a more elaborate unit, a table model similar to the portable but having a polished wood finish instead of black cloth is also available. The portable model is specially recommended for use in vacation camps, summer cottages, and other places where semipermanent installation is desired in addition to the carrying feature.

The speaker of this portable electric phonograph may be detached and hung up on a wall



A TONE CONTROL for auxiliary phonograph pick-ups is easy to make and easy to install. Consisting of a small audio transformer, a 50,000-ohm tone control, and a .1-mfd. tubular condenser mounted on a steel chassis, it is simply wired into the existing circuit between the pick-up and the "phone" terminals on the radio receiver.

Tone-control unit adds volume and quality to phonograph recordings



AUTOMATIC REGULATION of the line voltage within narrow limits, and a starting resistor which limits the current to 80 volts for the first six seconds the set is turned on, are features of this new ballast tube for radio receivers. After the first six seconds, it automatically regulates the line voltage. Designed for universal use, the tube can be employed as a replacement for about ninety percent of the resistor tubes now in use.



The finished set, ready for use as a radio or phonograph

Two-Tube Radio Phonograph

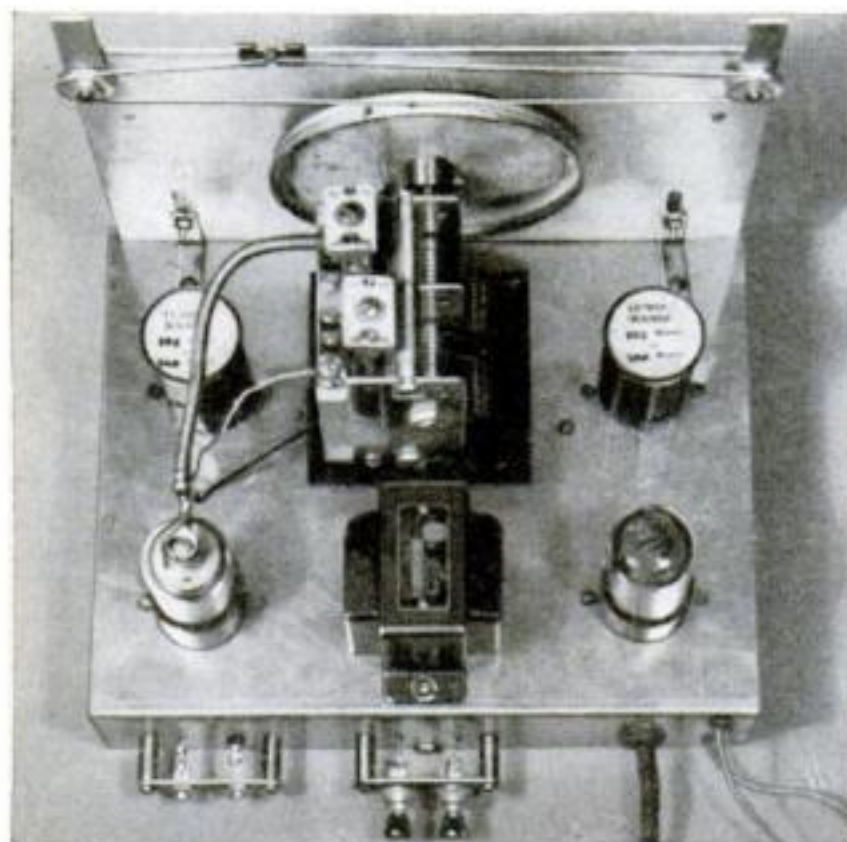
By FRANK TOBIN

records, a volume control (also working on either radio or records), a phono-radio switch, and a sensitivity control. The latter is really a regeneration control but differs slightly from the conventional type in that it can be adjusted to below the oscillation point and left in that position while tuning through the entire broadcast band. Usually a regeneration control must be reset as each station is tuned in. Another advantage is that it does not detune the set.

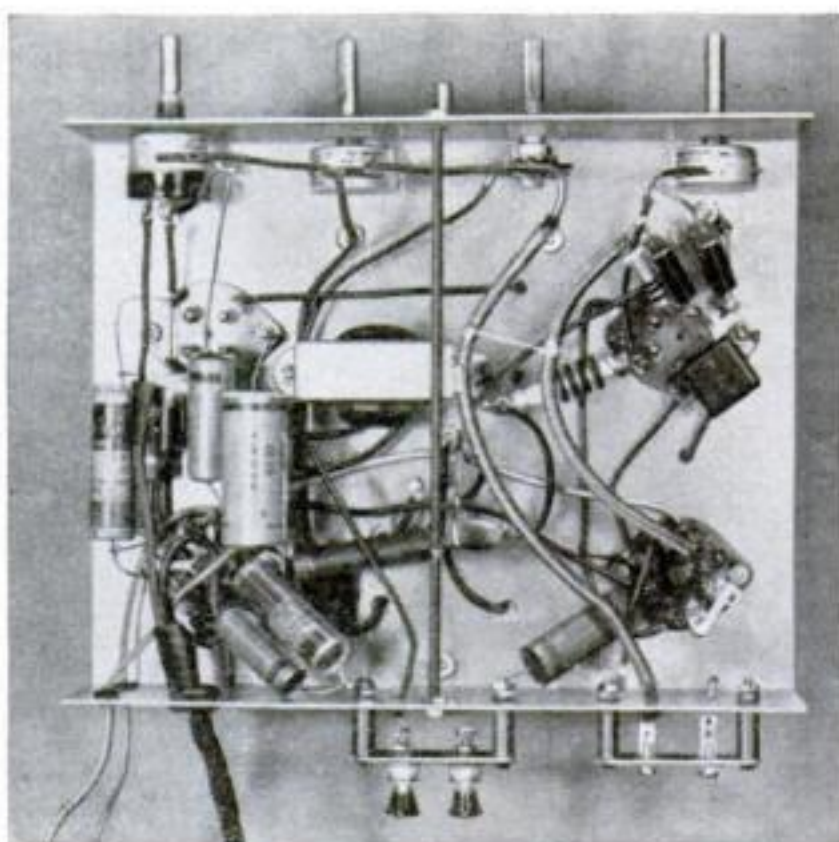
The reader should be able to duplicate this phonograph combination, including the commercial walnut cabinet, for \$27.50. This price includes tubes, pick-up, and phonograph motor.

Fundamentally, the circuit is a tuned radio-frequency receiver using a triode in the detector stage, and a 3:1 shielded transformer in the audio stage. Plug-in coils have been used in both the antenna and radio-frequency circuits. They are tuned by two .000365-mfd., ganged variable condensers. To balance the circuits satisfactorily, the original trimmers on the condensers should be replaced by two others of a slightly higher capacity (3 to 30 mmfd). The coils chosen must have a range of 185 to 360 meters (with a .00014-mfd. condenser). With the .000365-mfd. tuning con-

USING only two tubes, this radio-phonograph combination provides output and quality equal to sets using five tubes or more. It boasts all the features found in combinations using eight tubes, for the two-tube chassis incorporates a variable tone control working on both radio and



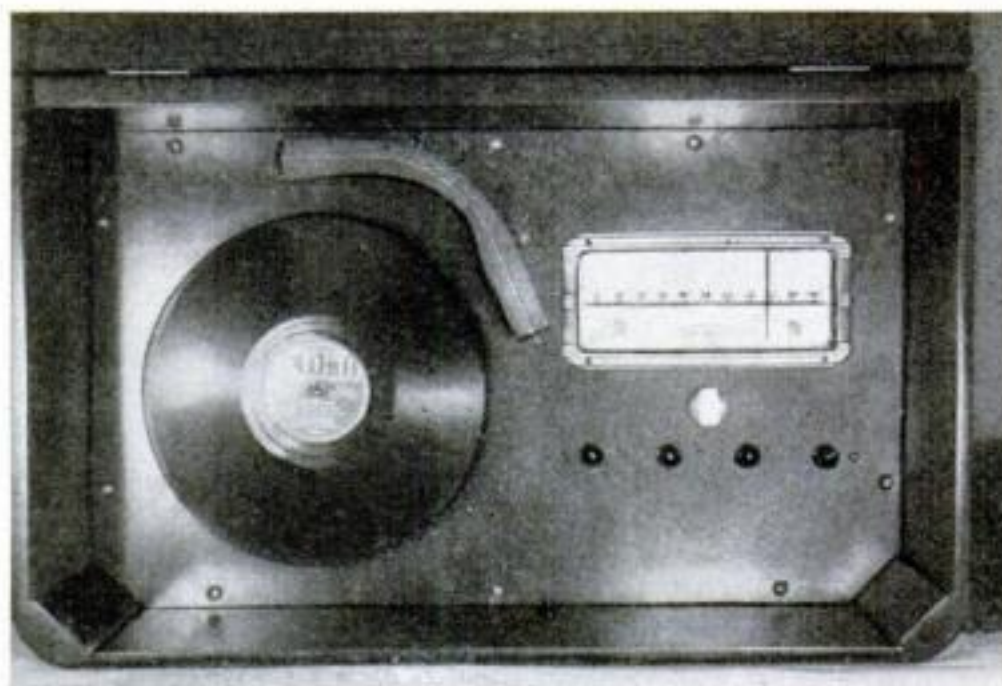
Extreme simplicity marks the layout of the parts on top of the chassis. Coils and tubes are accessible



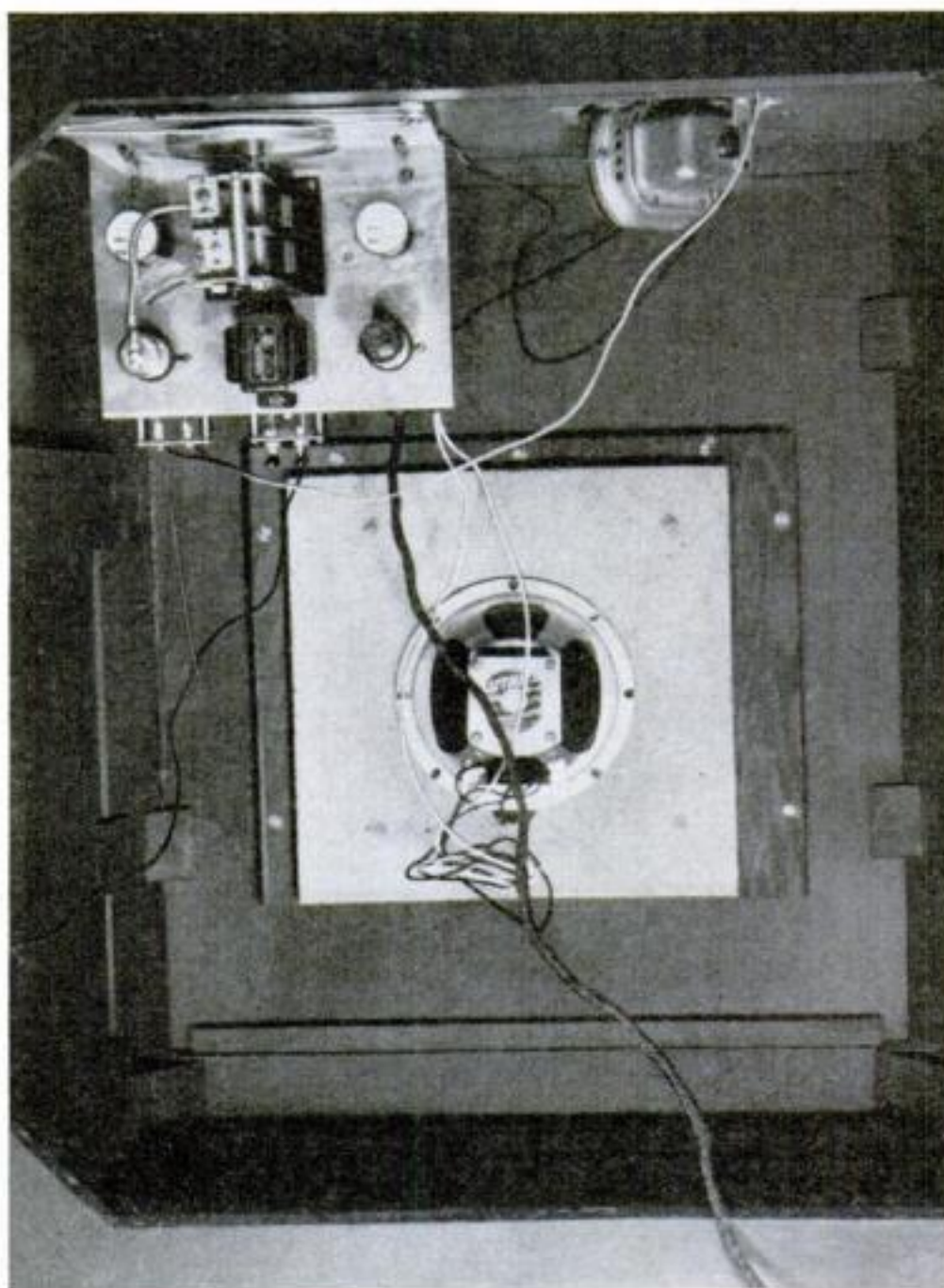
This view of the underside of the chassis will assist the builder in making the various connections

LIST OF PARTS

Six-inch permanent-magnet speaker.
 Output transformer.
 Radio-phonograph cabinet.
 Radio-frequency and detector tube, 12B8GT.
 Output and rectifier tube, 32L7GT.
 Line cord and resistor, 220 ohm.
 Four-prong plug-in coil.
 Six-prong plug-in coil.
 Two-gang tuning condenser.
 Eight-inch slide-rule dial.
 Aluminum chassis, 2" by 7" by 9".
 Audio transformer, 3:1 ratio.
 Variable resistor, 50,000 ohm.
 Variable resistor, 100,000 ohm.
 Variable resistor, 500,000 ohm.
 S.P., D.T. rotary switch.
 Filter choke, 13 henry.
 Radio-frequency choke, 2.5 mh.
 Crystal pick-up.
 Phonograph motor.
 Trimmer condensers, two, 3—30 mmfd.
 Electrolytic condensers, three, 8 mfd.
 Tubular paper condensers, two, .1 mfd.
 Electrolytic condenser, 25 mfd., 25 volt.
 Tubular paper condenser, .05 mfd.
 Mica condensers, three, .00015 mfd.
 Carbon resistor, $\frac{1}{2}$ watt, 2 meg.
 Carbon resistor, 1 watt, 600 ohm.
 Carbon resistor, 2 watt, 1,000 ohm.
 Mica condenser, .0005 mfd.
 Green pilot bulbs, two, 110 volt.



Top view showing phonograph turntable, radio dial, and controls



View from behind the set, showing how the parts are mounted

the grid of the output pentode. A single-pole double-throw rotary switch cuts out the secondary of the audio transformer when the pick-up is used. It is important to use a crystal pick-up with this circuit, as a magnetic type will not give sufficient volume.

Three 8-mfd. electrolytic condensers, a 13-henry choke, and a 2-watt, 1,000-ohm resistor, make up the filter network. In the wiring diagram, note that the "B" positive side of the output transformer is connected to a point between the filter choke and the 1,000-ohm resistor.

Get Started IN Radio

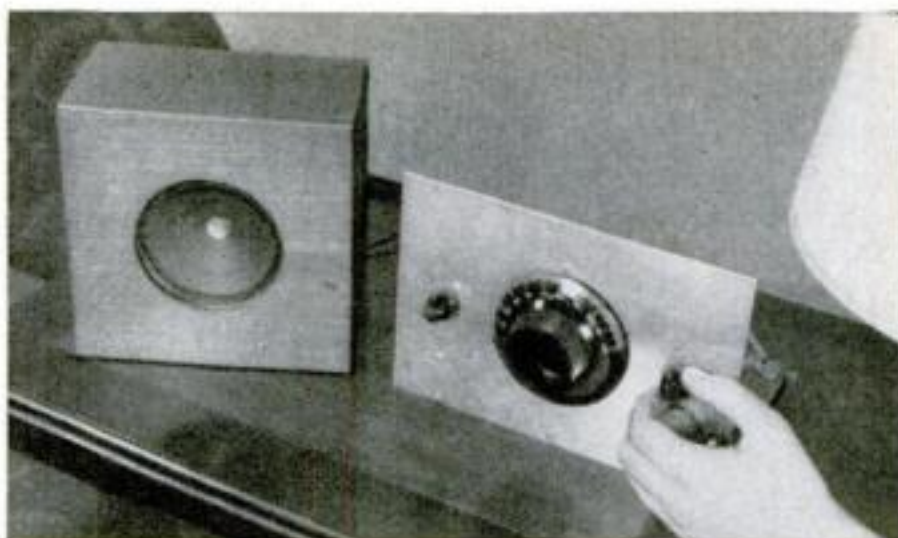
PART VI . . . TRF FOUR TUBER

THIS radio is the sixth and last in our "Getting Started for \$8.95" series. The set is a four-tube, tuned-radio-frequency receiver with an untuned stage of radio-frequency coupled to a tuned detector stage with regeneration. Only one coil and one tuning condenser are required, instead of a ganged condenser and a pair of matched antenna and radio-frequency coils. The antenna coil has been replaced by a 200,000-ohm, $\frac{1}{2}$ -watt resistor between the grid of the 25B8GT (pentode section) and the chassis.

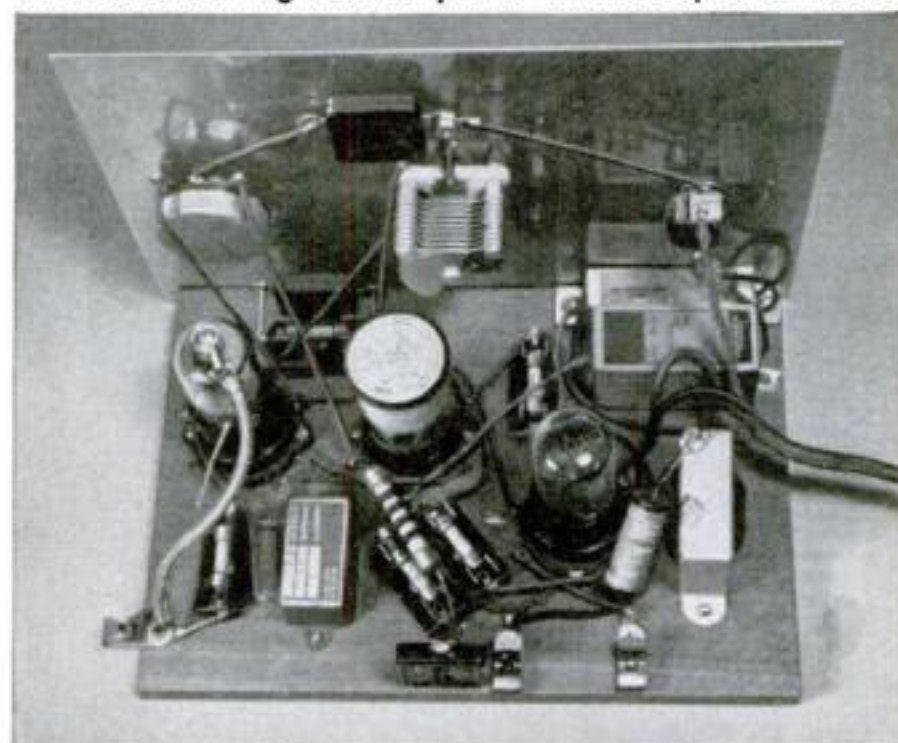
The radio-frequency portion of the set remains the same as in the previous article, except that an audio stage has been added. The audio stage is resistance-coupled. Bias for the pentode portion of the 70L7GT tube is obtained by means of the 600-ohm resistor and 10-mfd. electrolytic condenser.

The antenna should be from 20' to 100' long. No ground should be used unless it is attached to the chassis through a .1-mfd., 600-volt condenser.

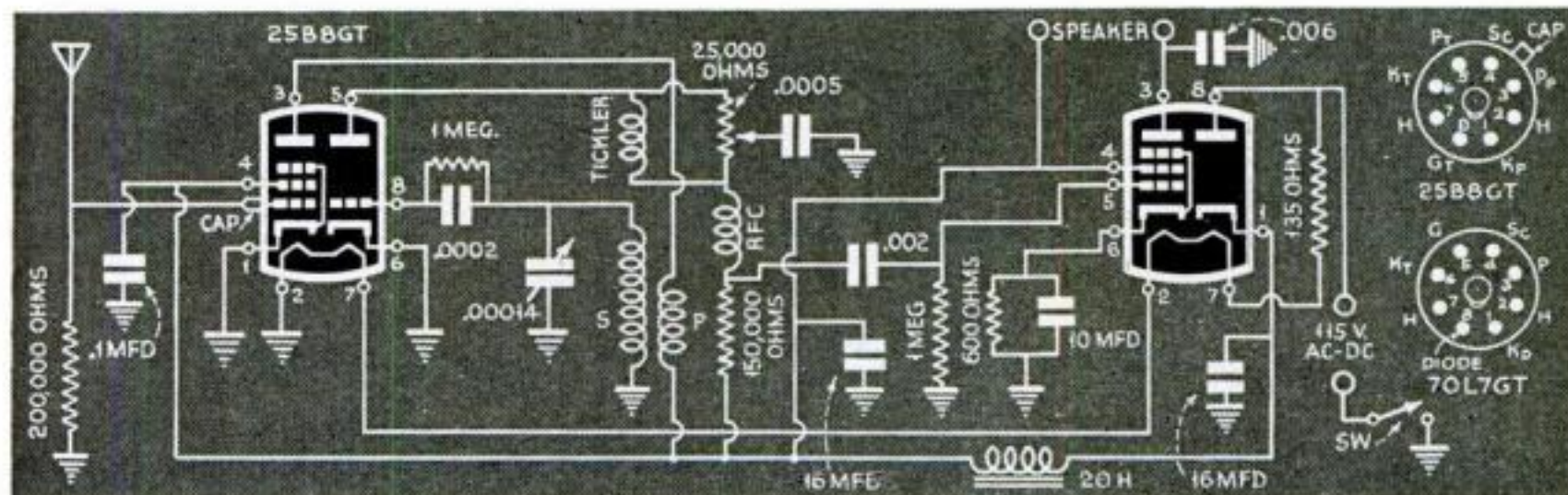
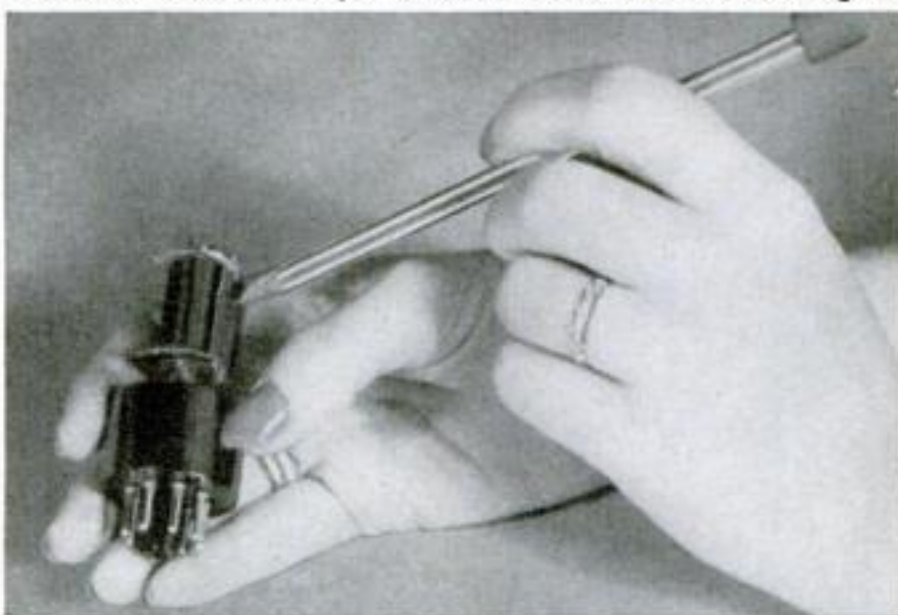
The dual-purpose 70L7GT tube with its glass bulb removed to show the cylindrical arrangement of the elements



Two tubes serving as four power this loudspeaker radio



The same chassis and panel used before can be used again



A 200,000-ohm resistor between the pentode grid and the chassis replaces an antenna coil in the hook-up

Flash-Master at Twenty-Three

Popular Science Interviews Photographer Ralph Morse

PROFESSIONAL photography is a fast-moving business, where reputations can bloom almost overnight. Ralph Morse, 23-year-old cameraman, has been working at photography a bit less than three years, and already has made a name for himself among the critical fellows of his craft for expert use of flash lighting.

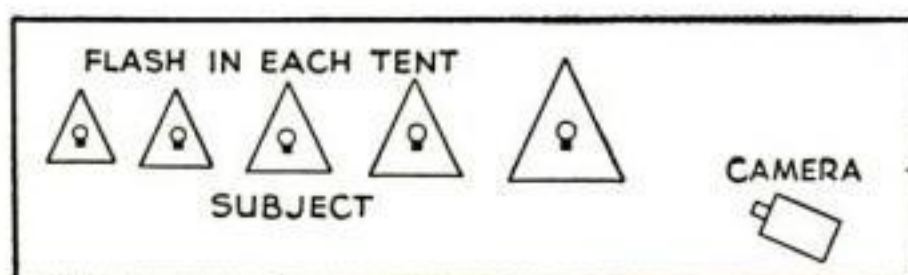
That and candid photography are his specialties. All his equipment is rebuilt and adjusted for his particular technique. On the job he carries a case like that used by most news photographers, but a press cameraman who looked inside it would get the surprise of his life. The camera, a Contax, is about the smallest thing in the case. Most of the room is taken up by 300 feet of extension wire, special battery box, re-

flectors, clamps, three-way sockets, and similar flash equipment.

He has fired flash set-ups strung out from 200 to 300 feet, involving as many as six bulbs. Ordinarily two or three will give the required effect.

"I never use regular lights any more," Morse will tell you. "It isn't necessary—you can do anything you need to with the flash. Of course, by that I don't mean that you can compete in perfection of pictorial quality with a conscientious photographic artist who works in his studio and takes four or five hours, if he wants to, working over one picture and trying endless combinations of light and arrangement. But that isn't the sort of work we do. On a commercial job or a news assignment you'd never be able to work like that."

Morse is a firm believer in the miniature camera, 35-millimeter film size. He uses

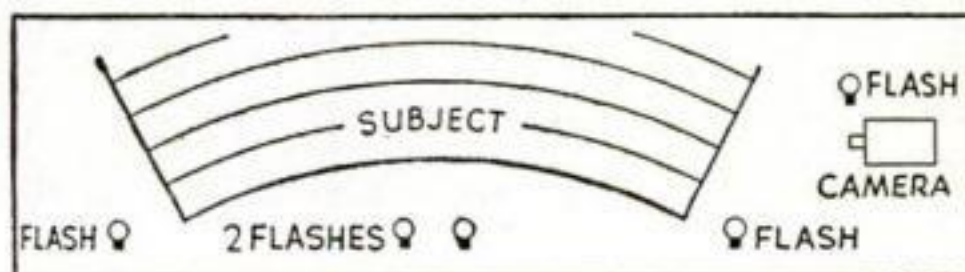


ARMY TENTS. Although Ralph Morse specializes in the multiple flash, he does not always use a synchronizer—and did not in this unusual night scene. He simply left the shutter of his Rolleiflex camera open on "time," then ran from tent to tent and set off an open flash inside each





GRADUATES SALUTE THE COLORS. This picture was taken at graduation exercises of the Manhattan School of Aviation Trades, New York. To illuminate the auditorium, Morse used five flash bulbs as in the diagram. This was a synchronized shot with Contax camera





PARK BENCH. A twenty-second time exposure brought in lamp-post and background lights. Morse then banged a double flash for the main exposure

a reflex (Rolleiflex) camera for some jobs, and has a Speed Graphic press camera which gathers dust most of the time, but is valuable for color work. On news assignments, where speed is at a premium, Morse says he has found that he can make four flash pictures with his Contax in the time needed to shoot one picture with a 4" by 5" press camera.

Speed may not be so essential in commercial or advertising photography, but Morse has found that it may be greatly appreciated. An ad agency which has hired two or three of the highest-priced models in the business (models are hired at an hourly fee) is glad to see the job put through without delay.

"It makes a difference in the posing of the girls, too," Morse comments. "Suppose the model is going to be photographed for an ad picture in which her hair is important. She has to have it waved and sit maybe an hour under the drying machine. Then if she has to sit for another long stretch under hot flood lights, waiting for the picture to

be set up, it's almost impossible for her to keep from getting 'posed' and unnatural. That can spoil the whole effect of the picture. You're much more apt to get a good, natural shot if you can line up and shoot a quick flash."

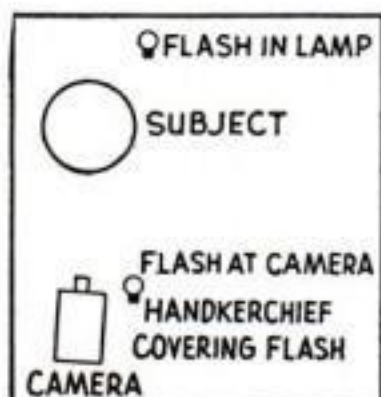
A picture taken in just that way, incidentally, is one of the prizes of Morse's collection. Most who look at the print are sure it was made with a fairly elaborate studio set-up. As a matter of fact, the model was posed seated four feet away from a blank gray wall; the camera was placed for a close-up of her head, and a single flash about six feet from the ground and a few feet off to the model's right made the exposure.

Morse, like many other photographers, tinkers with all his equipment, rebuilding and readjusting to suit his own notions. He uses a rebuilt Jacobson synchronizer on his Contax, but has it hooked up to a special 9-volt Kalart battery box. The extra voltage is needed to fire multiple flashes through a possible 300 feet of extension electric cord.

He fusses a lot over his reflectors, insisting on good quality equipment, built with an efficient curve to throw the light out evenly. All of them have spring sockets rather than the screw type, for speed in changing bulbs.

He very rarely takes pictures with a flash bulb mounted directly on the camera.

HOME AT NIGHT. A shot planned to give the effect of an ordinary room with normal light. Two flash bulbs and synchronizer were used. One was placed in the visible lamp; and the other, at the camera, was covered with a handkerchief



PORTRAIT IN SHADOW. Not an elaborate studio set-up, but a picture made with one flash a few feet to the model's right and six feet high



Sometimes this has to be done, of course, in getting fast action scenes. It is apt to result in flat pictures, with little quality or light form, however, and as a rule Morse prefers to use his extension cords to build up light quality.

He doesn't always use the synchronizer. In fact, he takes open flash shots on virtually all mass scenes. In this technique the shutter is held open, the flash fired, then the shutter is closed. It has two advantages, he says: You get the full light power of the flash, plus an additional exposure from the normal light present at the scene.

His "park-bench" picture is a striking use of this technique. This was a posed picture, made for a humorous series in a magazine. He first gave it a 20-second time exposure to bring in the lamp-post and background lights, then banged a double flash for the main exposure.

Another trick amateurs can use to add reality and sparkle to indoor shots is to have one extension flash concealed in a regular light-fixture near the subject. (It also is possible to hook the lamp up to your synchronizer through an extension cord and outlet socket.) Very often it is well to have another flash at the far side of the picture to balance the light, and Morse has found it best to diffuse the



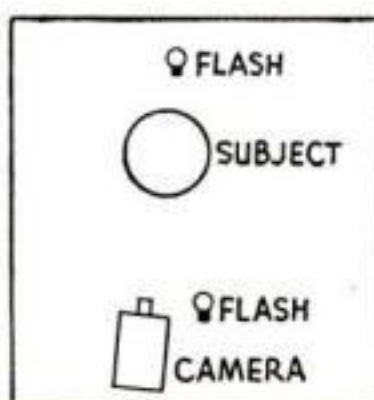
With a basket of bulbs, Morse rides to an assignment in Nassau, B.W.I.

light from the open flash by placing a handkerchief over the bulb.

The use of the flash outdoors and in sunlight has been talked about almost too much and has become surrounded with unnecessary confusion, Morse thinks. The mistake most amateurs make in this field, he says, is to forget about the sun-

light and shoot as though they were doing flash work at night or in deep shadow. His idea is rather to make the exposure for the sunlight, using the flash as a balance.

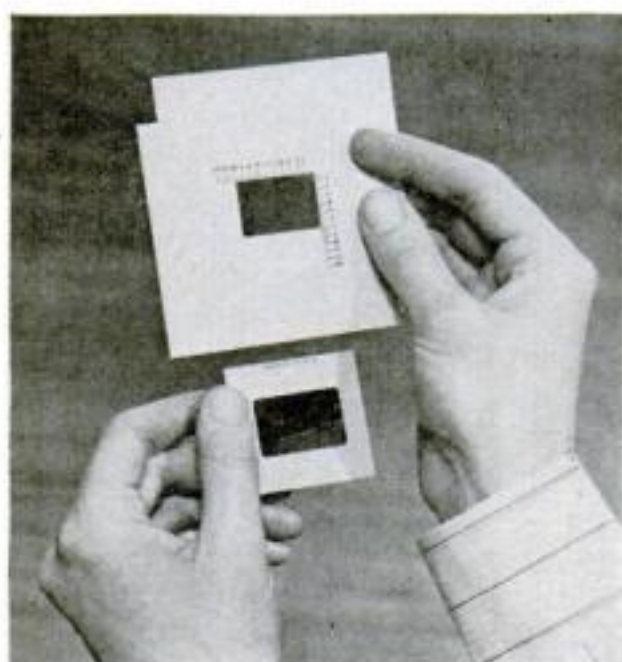
After graduation from high school, Morse pestered photographers until finally Paul Parker took him on. Later he switched to his present job with Pix Incorporated, New York, where his 300-foot extension cord is already something of a legend.



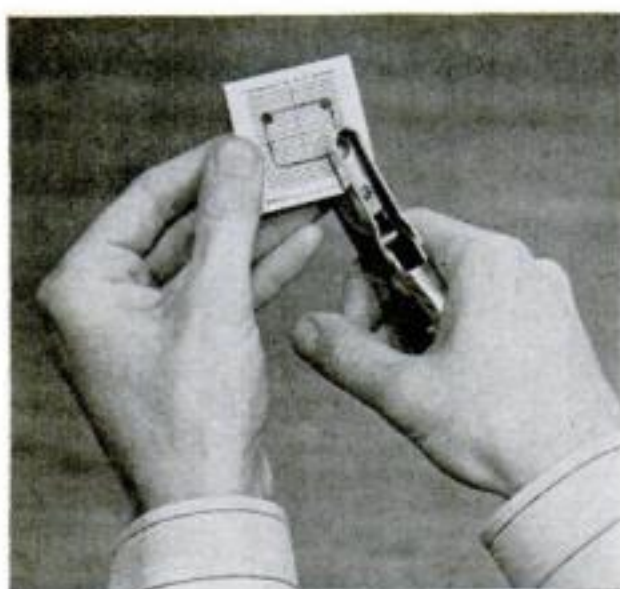
DRESSMAKER. Morse has a trick of placing his flash bulbs where they bring out the most dramatic pictorial possibilities. Here he used two bulbs. The second was located unconventionally behind the model's dress and used without reflector

Masking Your Projection Transparencies

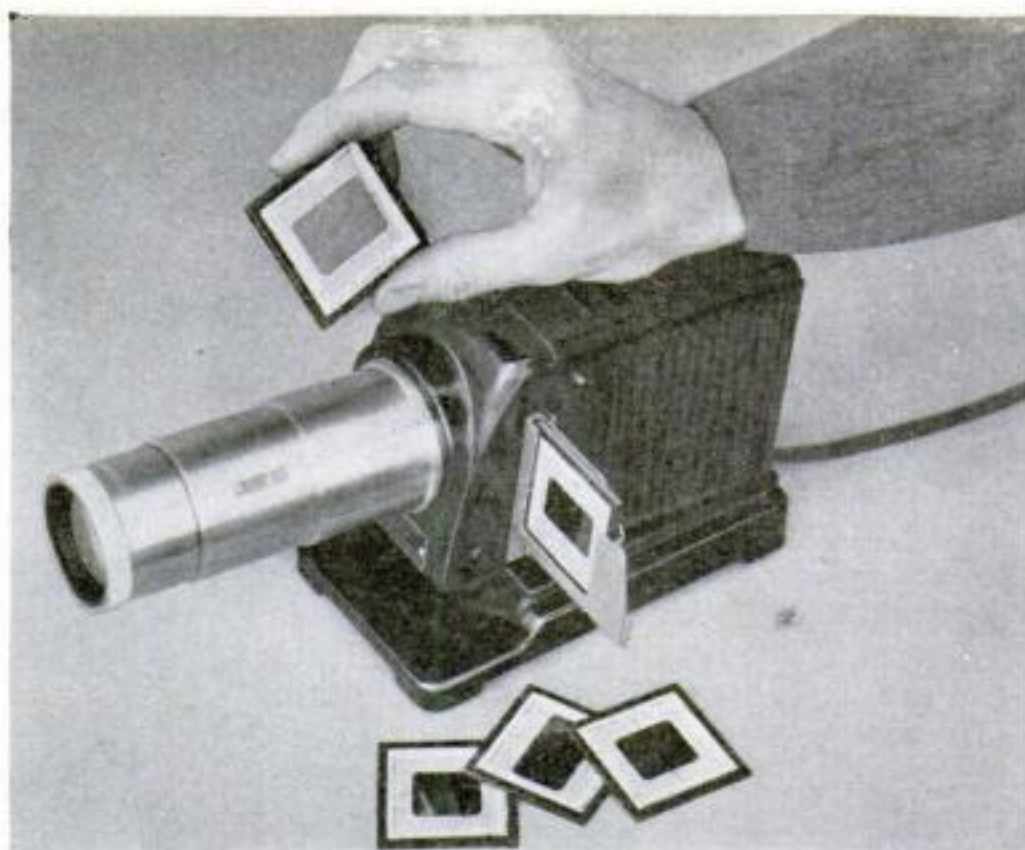
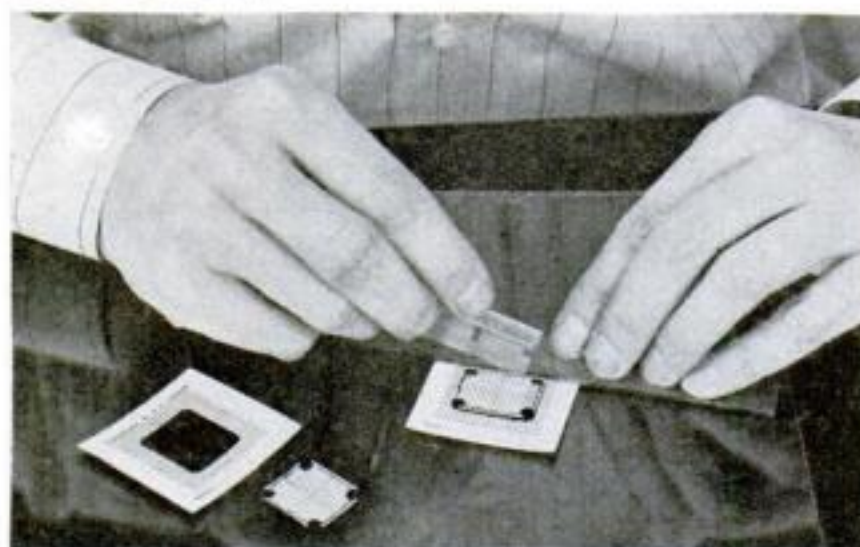
By S. Y. CALDWELL



Two cards with 1 1/2" square openings cut out of their centers serve as a sort of "finder" to determine the best masking for each color transparency



A rectangle of the required size is then marked on a mask, and a ticket punch is used to make a hole at each corner, after which the opening is cut out as shown at the right



MASKS of appropriate size and shape will improve your 35-mm. natural-color transparencies as much as intelligent cropping helps photographs on paper.

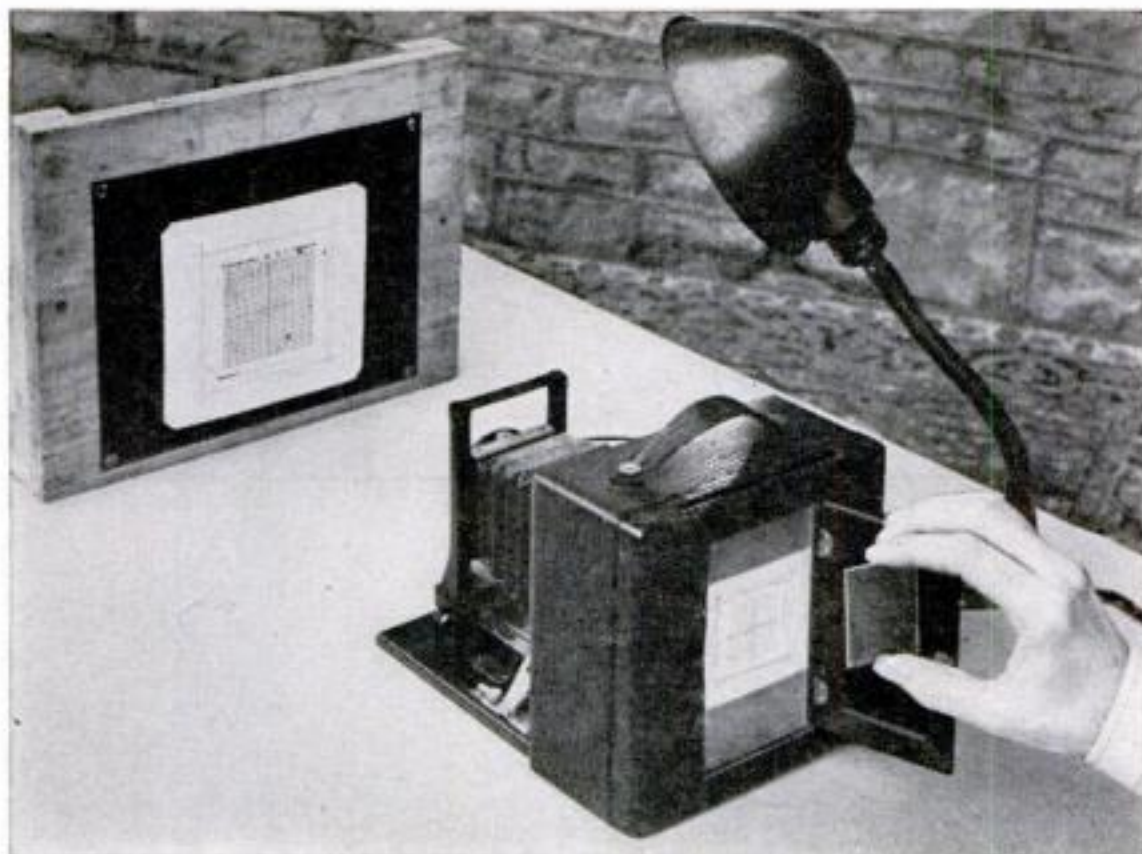
With India ink rule a mask chart pattern as shown on smooth white paper. The marginal lines are an exact 4" square, with corners "bleeding." The inner area is 2 3/4" square with crossed lines 1/8" apart. If your camera uses film size 828 instead of 35 mm., make this cross-hatching 3" square, so that your finished masks will accommodate the full picture size. Note that the two lines crossing in the center of the chart are made extra heavy.

A title, credit line, or any other caption desired may be hand lettered or typed. In the example illustrated the words were set in printers' type, a proof was pulled, and the printed line was cut out and carefully pasted in place.

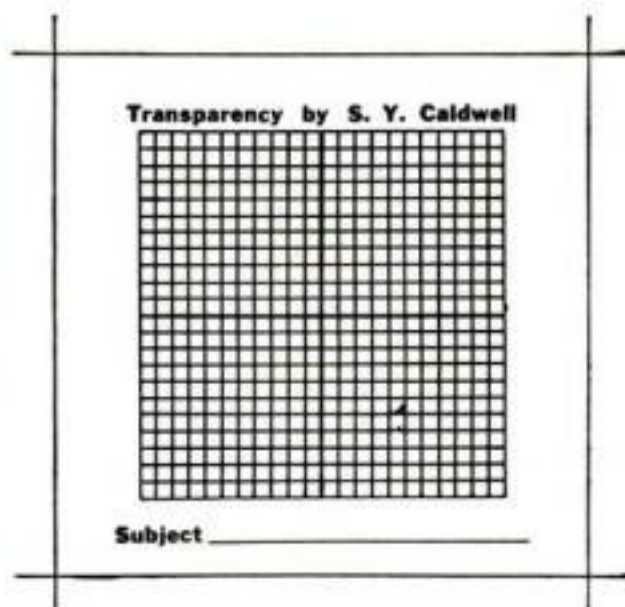
A ground-glass, focusing-back camera is necessary for the next step, which consists in copying your chart pattern, so as to reduce it to the standard size. See that the pattern and camera back are in absolutely parallel planes to give a perfectly accurate copy with straight lines and square corners. When focusing, hold a slide cover glass against the ground glass, and adjust distance of camera to copy until

the focused image of the chart outline coincides exactly with the outline of the cover glass. Your masks will then be just the right size, slightly under 2" square.

This copying is best done on slow, contrasty film, developed in a high contrast developer. Make prints by contact on any



The mask chart is drawn as shown below. It is then set up as at the left and photographed to the exact size of the usual 2" cover glass



hard grade single-weight paper about $2\frac{1}{4}$ " square. Process and dry them as usual. Brush India ink over the back of the prints with a small camel's-hair brush to make the paper opaque. Trim along the marginal lines, and the mask charts are ready for use.

Provide two pieces of cardboard about $3\frac{1}{2}$ " square, with $1\frac{1}{2}$ " square openings cut out of their centers. One of these should have its opening marked along two adjoining edges in $1/16$ " steps, to correspond with the $1/16$ " hatching on your mask charts. By holding these cards together and sliding one over the other you can make any size or shape of opening up to the full size of your film.

To frame a transparency, hold it up to the light in the cardboard mount in which it comes, and make experimental adjustments of your framing cards over it. Mask as you would crop a paper print.

When the opening seems just right, read

its dimensions from the scale on your framing card. It is then simple enough to lay out on a mask chart a similar opening, centering it by means of the heavy horizontal and vertical lines that cross in the middle. Outline your opening roughly with pencil or ink just inside the chart lines that will serve as a guide in cutting.

A ticket punch that makes a $1/8$ " round hole is next used to punch a hole at each corner of the indicated opening. Then lay the chart on a sheet of glass, place a ruler as shown, and trim from hole to hole with a razor blade.

Remove your film transparency from its cardboard mount and place it against the back side of its tailor-made mask. Slip it about until exactly the right portion is framed by the mask opening and tab it in place with a bit of cellulose tape along an edge. Bind the assembly between cover glasses in the usual manner.



Wind-Tossed Trees Used in Amateur Movie Title

THE close of winter brings many opportunities to the amateur movie-maker. There seems to be action everywhere as life begins to stir with the impulses of spring. This is typified by the March winds as they whip flags about, toss the boughs, and make pedestrians bend picturesquely against the strong, chill blasts. That is why the current title was selected as an appropriate one for March.



Konrad Cramer, who is a master of film technique, examines a negative in his studio

How to Develop Your Film

By KONRAD CRAMER

Director, Woodstock School of Photography

REAMS of paper have been covered with countless words . . . hundreds of books have been published on this subject . . . and every month new cure-all developers are recommended to the amateur photographer. This article will attempt to bring some order out of this chaos.

Don't ever delude yourself into thinking that any new developer, no matter how fancy its name, will make a good picture out of a bad one. If you put a snapshot of your backyard in the developer, you should not expect to pull out a sunrise on the Mohave Desert. If you once honestly face the fact that any developer acts chemically, not artistically, you will be content with your developer formula and then can devote the time, energy, and money saved to the

actual picture-making part of photography.

The following instructions are intended to show the amateur who has never developed a film the best and simplest method of converting the latent image into a negative. It is also hoped that the amateur who is already developing his own film will be set right and saved from an endless chain of futile experimentation with every new formula and process.

First, stick to the developer recommended by the manufacturer of whatever film you habitually use. Choose an Eastman developer for Eastman film, an Agfa developer for Agfa film, and a Dupont formula with Dupont film. Each manufacturer's developer formula is carefully adjusted to his various emulsions and gives best results.

To begin with, select a medium speed panchromatic film—one that responds to all colors and is more like the human eye. This type of film will photograph anything except black-and-white print and reproductions, for which a special contrasty film called "process" film should be used. Special films for portraiture are not recommended in the beginning.

When you load your camera with the film, open the box in as dark a place as you can find. Handle roll film gently, and don't press it sideways as that may let the light penetrate between the layers of protecting paper. Close your camera and sit down and read the manufacturer's instruction sheet.

These instructions may tell you to develop your film in fine-grain borax tank developer at a temperature of 65 deg. F. for from 9 to 12 minutes. If you leave your film in the developing solution for 9 minutes, you get a film that is known as "thin" (you can read news print through it). This is also known as a film of low gamma (0.65). If you leave your film in the developer for 12 minutes, you will get a dense negative. This negative looks blacker, and print can be read only through the most transparent parts. This indicates a high gamma (0.9-1).

The developers may be bought ready mixed from the manufacturer of the film, or mixed by yourself. If you mix your own, you must exercise great care in compounding the formula. In the beginning it is best to buy the factory-prepared developer. The liquid form is preferable to dry mixed.

To develop a negative, you will need a darkroom, which means a place that can be completely darkened. Running water is very desirable. If you cannot contrive an entirely dark room (no light must be visible after you have been in this room for five min-

utes), it is better to depend on a good changing bag. You can buy or make one out of double layers of black rubberized cloth. A wire frame that holds up the upper part of the bag is very useful.

Whether you use a darkroom or a changing bag, test them for safety of your film. Take a piece of film and place on its emulsion a few metal washers or coins, leave them undisturbed for about ten minutes, then develop the film. If the metal washers have left a perceptible mark on the film, your darkroom or changing bag is not safe.

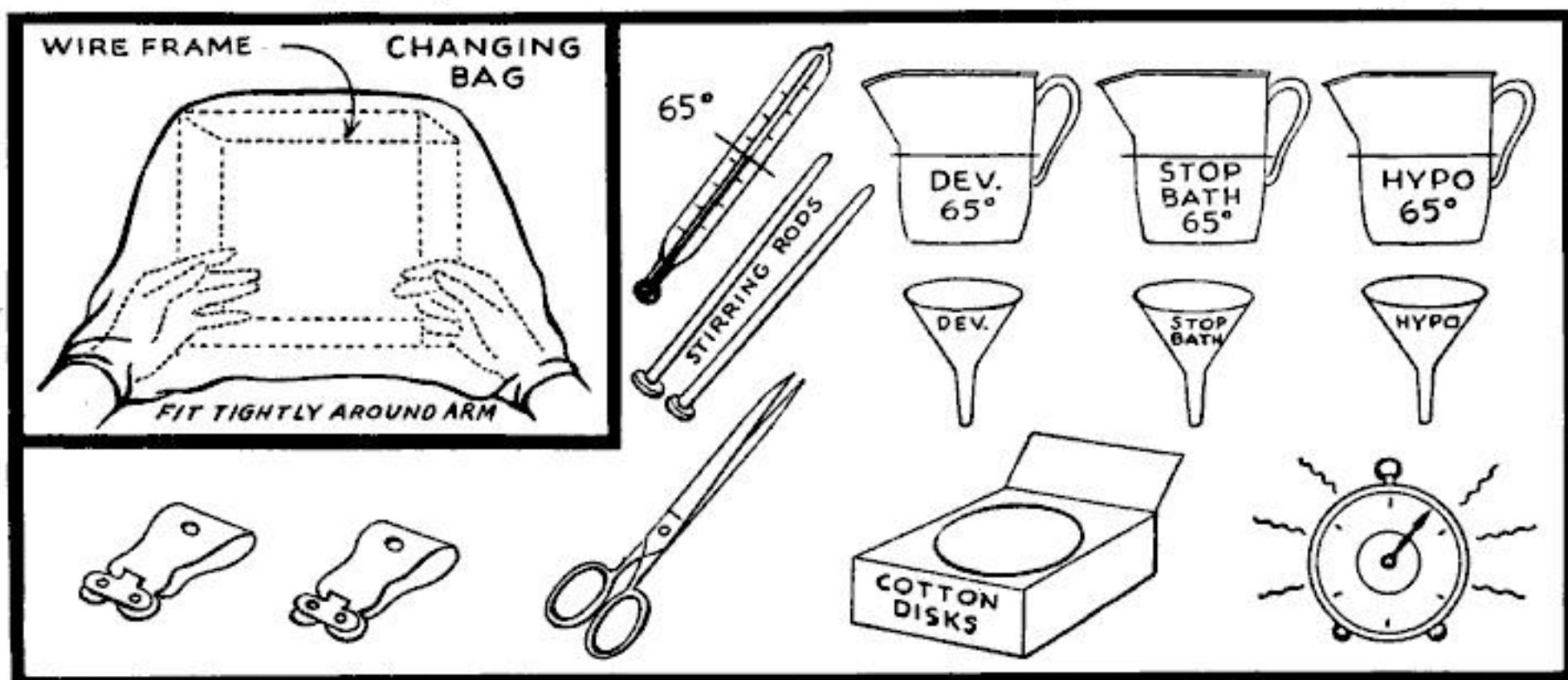
Whether your camera takes roll or cut film, it is best to use one of the daylight developing tanks on the market. Most roll-film developing tanks, however, are poorly designed. They do not permit sufficient circulation of the developing solution, and uneven development of the film is likely to result. Select a large-diameter reel and tank. Being able to rotate the film reel inside the tank is highly desirable. Make sure the lid of the tank closes light-tight. Once you have loaded the exposed film into the daylight tank in the dark, you can continue the operations in the light, but don't develop in direct sunshine.

To complete the development of your negative, assemble the following on a tray: Three 32-oz. graduates, from one to three thermometers, two or three stirring rods, from one to three glass or plastic funnels, an interval timer, cotton milk-filtering disks, two film clips, and scissors.

After the film is safely in your developing tank, bring the proper amount of developer, hardener, and hypo to the same temperature (65 deg. F.). Be very particular about this! It keeps the size of the silver grain to a minimum.

Pour the developer rapidly into the de-

A changing bag with wire framework, and a chart showing accessories for developing



veloping tank. Set the interval timer for the correct time. Jar the tank down smoothly on the table to free any air bubbles that might be adhering to the film.

During development, agitate the film according to the manufacturer's instructions. There are two kinds of agitation. One is intermittent—for about 30 seconds every two minutes. The other is constant agitation; you have to rock the developing solution constantly in all directions. If the manufacturer says that the correct developing time with constant agitation is 5 minutes, the correct time for intermittent developing would be $7\frac{1}{2}$ minutes, or 50 percent longer.

As the ringing of the clock indicates the elapse of the correct time, quickly pour the developer from the tank back into its own graduate. As quickly as possible pour the hardener (65 deg. F.) in the tank and shake the tank vigorously for about 30 seconds. Pour the hardener away (it should be used only once).

Pour the hypo (65 deg. F.) into the tank, shake and jar loose any air bubbles, and agitate intermittently for from 15 to 30 minutes, depending upon how fresh the hypo solution is. After complete fixation, pour the hypo back into the stock bottle and wash your film in running water for from 15 to 45 minutes.

The more efficient your method of washing, the less time it will take to dissolve the unused hypo out of the emulsion. Hypo is heavier than water and must be drained off from the bottom. A cardboard ice-cream container may be prepared with just enough small holes to maintain a constant level of water sufficient to cover your film at all times. This simple method washes a 35-mm. film in 12 minutes. Remember it is much

better to wash your film too long than to wash it for too short a time.

While film drying seems the least important stage of the developing process, most beginners commit the majority of blunders during this final operation. Remember that the emulsion side of the film (the one that is not shiny and has the gelatin and silver on it) is especially soft and tender.

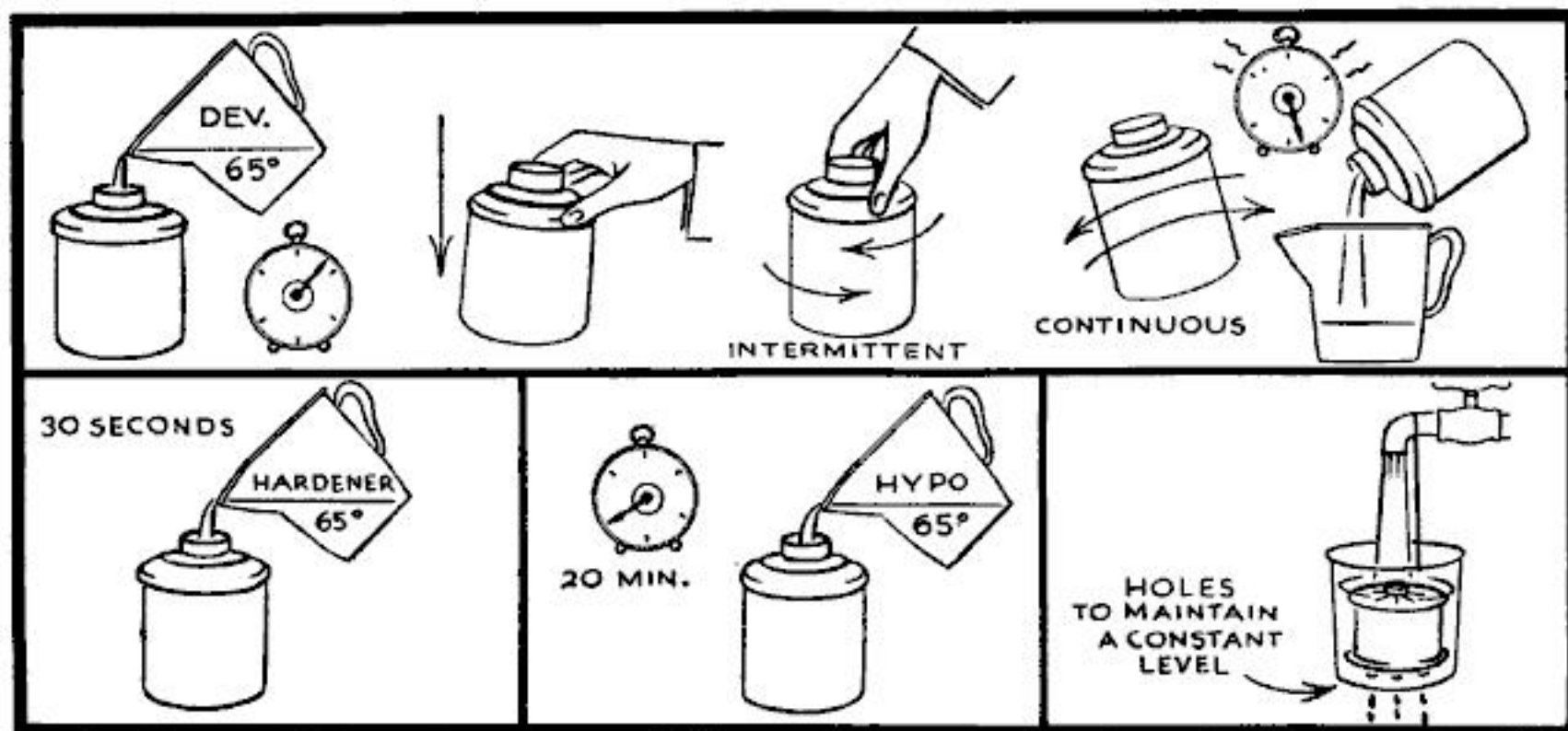
The best material for drying film is wet cotton. Ordinary wet cotton, however, has the disadvantage of depositing some of its lint on the film. The writer prefers to use fiber filter disks intended for cream separator machines. These are cotton disks $6\frac{1}{2}$ " in diameter, covered on one side with gauze. They cost about 45 cents a hundred, and can be bought from large mail-order houses that carry dairy supplies.

After the developed film has been sufficiently washed, lift the film reel from the water, fasten a film clip to the free end, and hang the clip from some point above your head. Then slowly and carefully unroll the wet film and fasten the second film clip to prevent the film from curling up.

Now take out a cotton disk and fold it in half. Hold it under the water till well saturated. Don't squeeze the cotton dry. Make a sandwich out of your index and middle finger, with the cotton disk held as shown, and with the film strip in the center. Don't attempt to wipe the water from the film, but move your hand with the cotton pad gently and very slowly downward. This removes the chemical scum left by the developer. Now refold the disk so that the clean outside surface is on the inside, and lay it aside on a clean surface.

Grasp the film strip with both hands, hold it under a sprinkler faucet, and spray first one side, then the other. Pass the film strip

All the steps in developing are comparatively simple, but they should be practiced until automatic



back and forth from right to left. This vigorous sluicing will remove any free particles. Suspend the dripping film from its support, pick up the folded cotton disk, and squeeze the water out of it a little more than for the first wiping. Repeat the wiping action with a little more pressure, but move your hand down even slower because now you want the cotton pad to absorb as much moisture as possible. Having reached the bottom of the film, give each film clip a pat with the dry-squeezed cotton pad to prevent water that has accumulated in the clips from running onto the drying film.

Now for drying. All directions tell you to dry your film in a dry, dustproof atmosphere, but that is not always easy. There are no such things as dustfree rooms, but it is most important that this ever-present dust is in no way stirred up.

Slow drying is thought to influence the size of the silver grain. It is preferable to suspend your film horizontally for drying. Don't ever dry the film in direct sunlight. If, on a rainy day, you hope to dry your film more quickly by blowing air from a hair dryer on it, be sure that you don't pepper it with dust specks. Should a small bit of cotton fiber become lodged on the drying film, leave it there until the film is thoroughly dry.

An excellent film cleaner, indispensable for 35-mm. negatives, is given in the "Leica Manual," published by Morgan and Lester, New York, page 130, as follows:

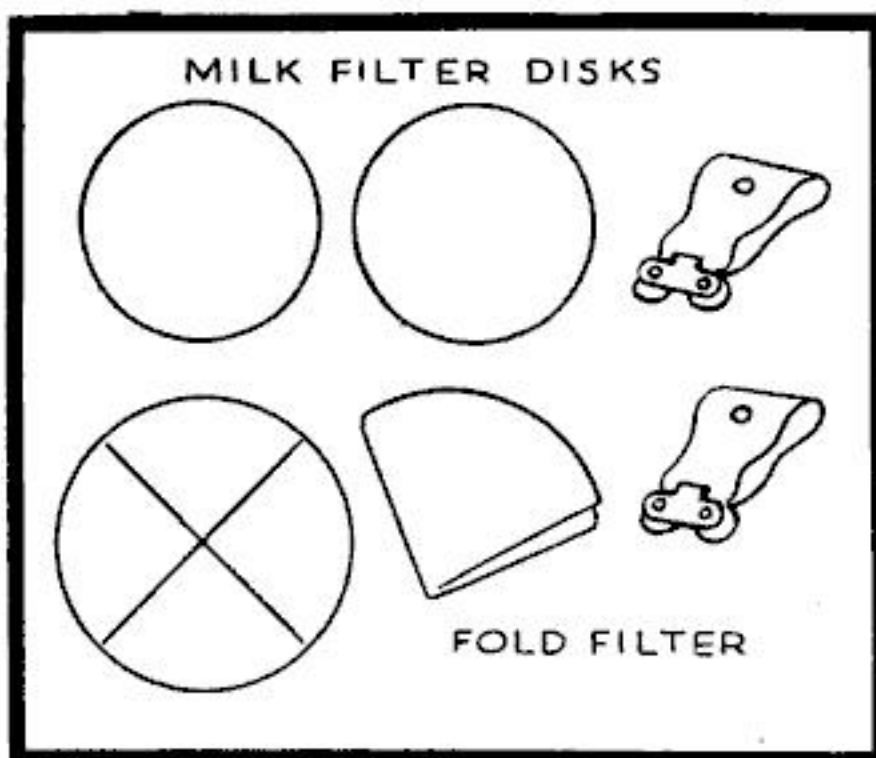
Ethyl alcohol (pure grain) 85 percent (or 17 parts)
Methyl alcohol (wood grain) 10 percent (or 2 parts)
Strong ammonia 5 percent (or 1 part)

This cleaner is not "dry" like carbon tetrachloride and similar cleaners. Being "wet," it does not charge the film electrically and thus leaves it without the usual tendency to attract lint and dust from the air. Apply it to both surfaces of the film with a clean, lintless fine linen cloth or soft chamois.

In closing, let me beg you to be kind to your processed negatives. Don't leave them lying about carelessly. There are many convenient envelopes and containers that will serve to keep them in good condition.

The preceding manual operations refer to daylight tank development of roll film, pack film, and cut film. Tray developing is best carried out in total darkness by the same time and temperature method. Even if the beginner turns on enough light to see the film while developing, he would not know how to interpret what he saw. Later, when he is familiar with negative quality, he might profitably develop a few negatives by inspection, first carefully desensitizing the emulsion, but that is beyond the scope of this article.

MARCH, 1941

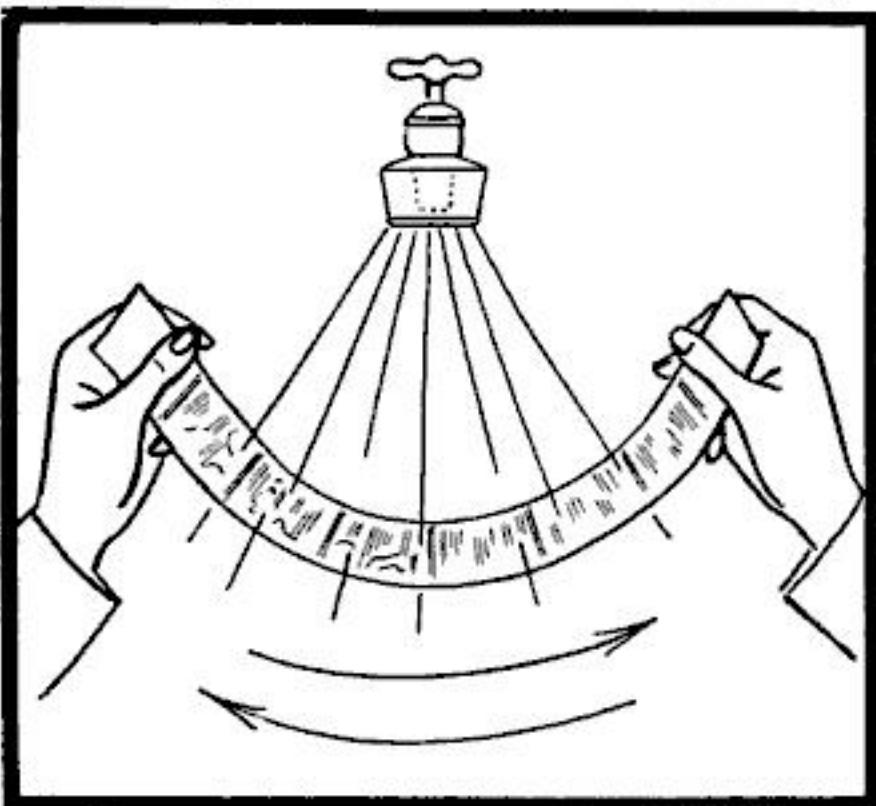


For wiping film, Mr. Cramer has found nothing better than the filter disks sold for cream separator machines. These are folded as shown



The disk, one side of which is covered with gauze, is moved gently and very slowly downward over the wet strip of film in sandwich fashion

To give a sparklingly clean surface, the film is given a final thorough rinse under a faucet with a sprinkling attachment. It is then wiped dry



Transferring Photos to Glass and Other Materials

PHOTOGRAPHS can be transferred easily to glass, celluloid or plastics, wood, metal, cloth, or even eggshells with the aid of a package of so-called "stripping paper" or "tricolor registration paper." This is sold for use in making natural-color prints and can be obtained at any large photographic supply house. Its speed is about halfway between that of fast bromide paper and ordinary contact paper, so it can be printed either by projection or contact.

A developer formula accompanies each package, but trial shows that any standard paper developer is satisfactory. After being developed and fixed, the image, on its thin celluloid support, will separate from the backing paper after it has been in the wash water for about ten minutes.

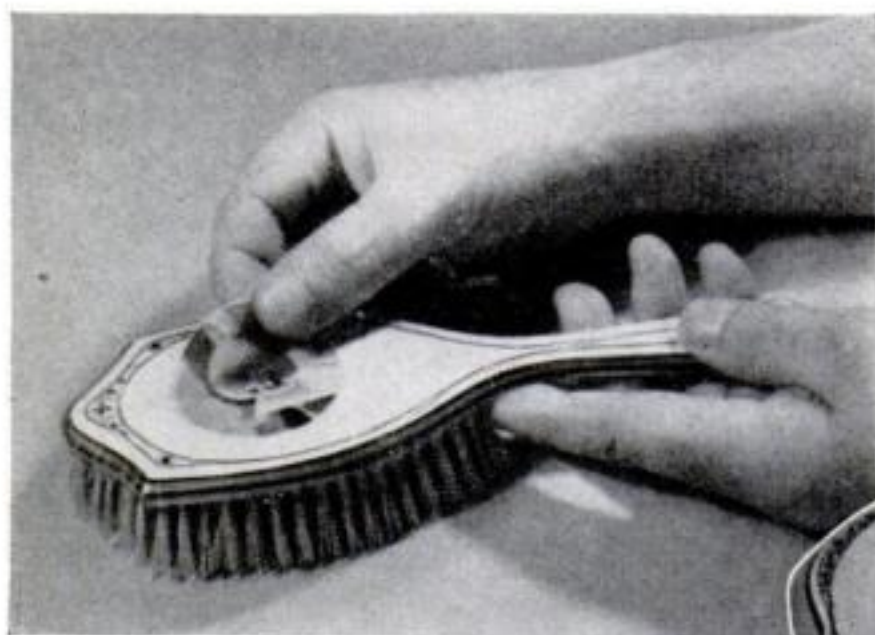
After the washing process, all excess water should be blotted from the prints, and they should be applied to the surface before they are entirely dry, because when dry they curl and become unmanageable. If it is ever necessary to let them dry for future use, soak them before application for ten

minutes in a solution of five parts water and one part glycerin.

In case the photographs are to be applied to a dark-colored surface, a positive instead of a negative should be used in printing. The thin films will then be negatives and must be reversed into white positives by soaking for a minute in a solution consisting of 20 grains of mercury bichloride to each ounce of water. The solution is very *poisonous* and must be handled with the *utmost caution*. Rinse the reversed prints in water before use.

Sandwich the moist prints between pieces of waxed paper in order to trim them to size or shape with scissors. They are attached with the glossy side out. The cement to use depends on the material to be decorated. A syrupy solution of gum arabic in water is satisfactory for wood and other material that is not highly polished; for glass, celluloid, and plastics use Canada balsam or a good grade of varnish. Never use cellulose cement, which would dissolve the thin celluloid film that supports the image. Rubber cement is satisfactory where absolute permanence is not required.

Cloth-mending tissue offers an easy method of attaching photographs to doilies and similar articles, but do not use an iron that is too hot. Cloth articles must be laundered with care. The prints may be tinted on the emulsion side.—KENNETH MURRAY.

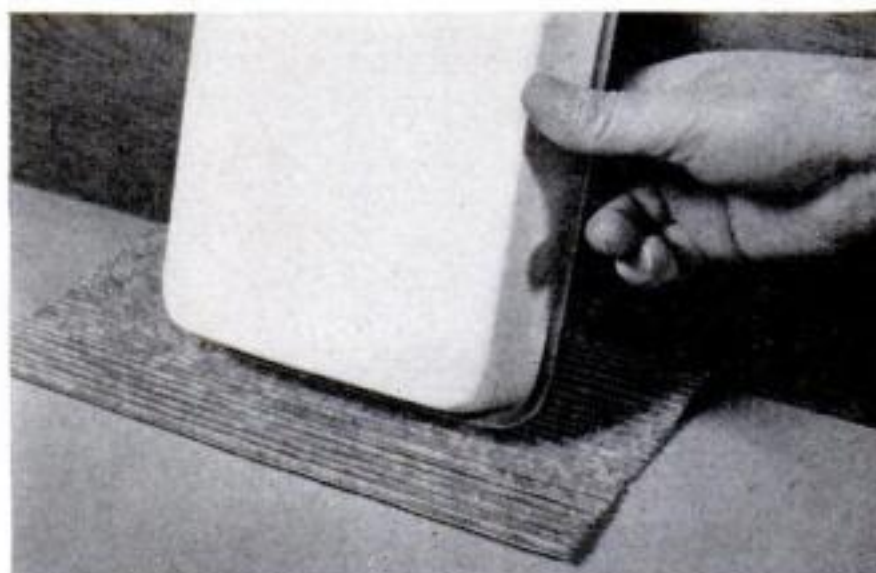


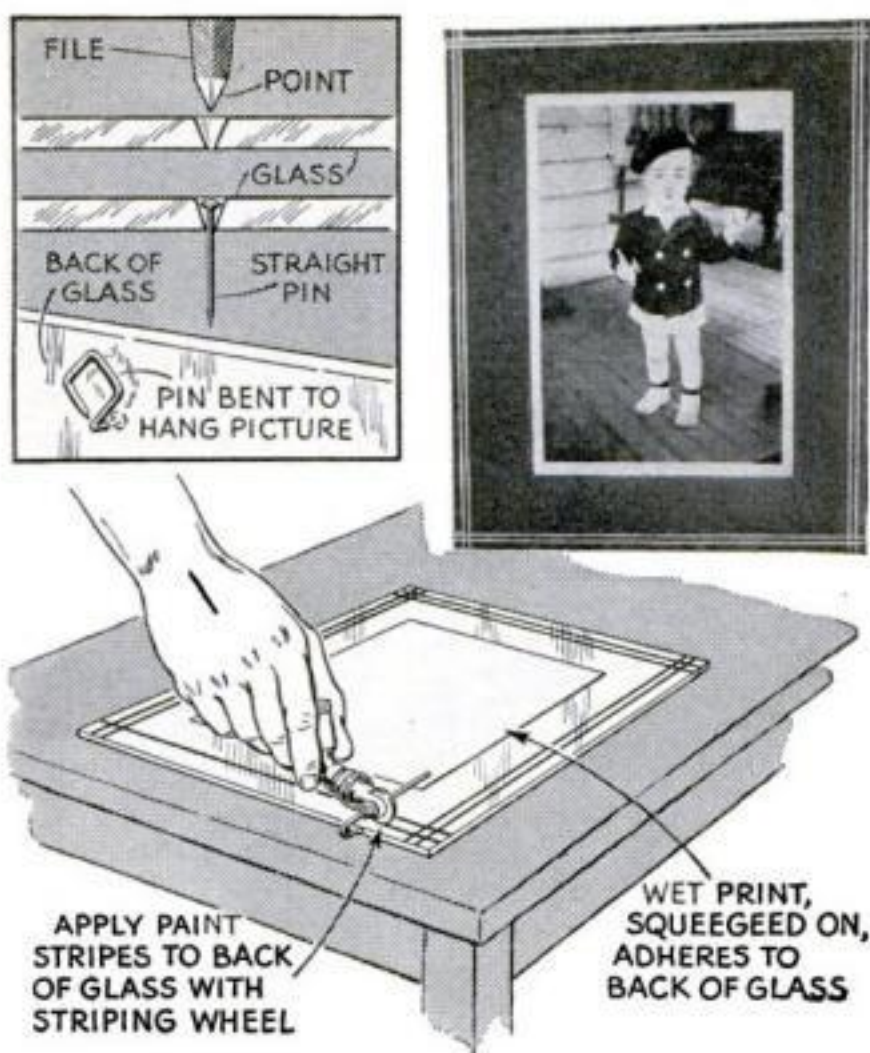
Attach the photograph to the surface while it is still moist. Right, finished pieces



Corrugated Cardboard Keeps Photo Trays from Slipping

WHEN developing trays are rested on edge on a darkroom bench or worktable, they have an annoying habit of slipping and often become chipped when two or more fall together. A mat or rest that will prevent this can be made by giving a piece of corrugated cardboard several coats of lacquer to stiffen and waterproof it. This is attached to the bench with thumb tacks.

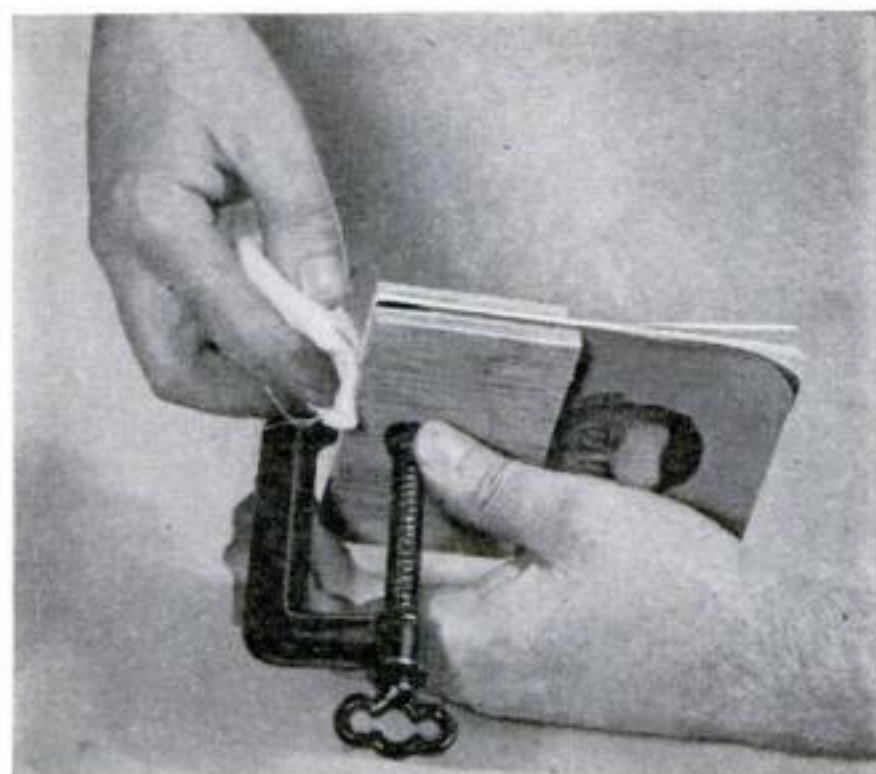




How the glass is drilled for the hanger; method of striping the border lines; and a finished mount

Edges of Photo Prints Colored to Give a Decorative Effect

SMALL photographic prints may be given a more attractive appearance if the edges are coated with gold or silver bronze or tinted red or some other color with photographic water colors. Jog a number of prints together until the edges are even, then clamp between strips of wood as shown below. Apply the liquid sparingly with a clean cloth. Allow the liquid to dry before treating an adjoining edge.—W. K.



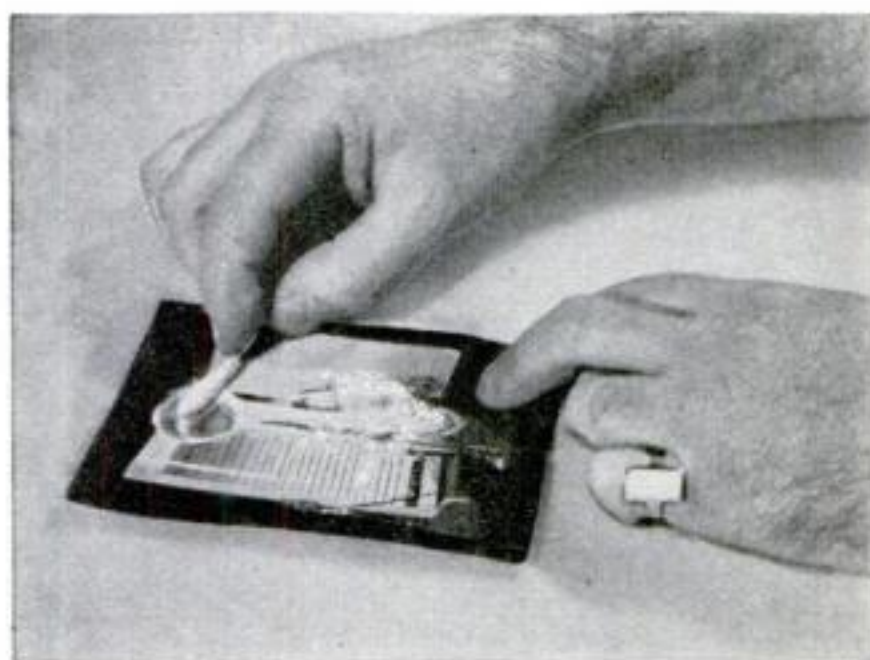
Bronzing edges of prints. This gives an effect similar to that seen on high-grade playing cards

Photographs Neatly Mounted on Glass Without Frames

MANY an amateur photographer has tried to ferrotype glossy prints on glass and discovered to his dismay that they will not peel off. This adhesiveness can be used to good advantage in framing 5" by 7" glossy prints on 8" by 10" sheets of good quality glass, as shown at the left. Merely soak the print in water for half a minute and squeegee it onto the glass, which should be well cleaned beforehand.

For hanging the glass, a hole may be drilled with a three-cornered file ground to a triangular point and lubricated with equal parts of camphor and turpentine. Stop as soon as the file point goes through the glass. This will give a hole large enough for a pin to pass through, but not the head. Bend the pin as shown.

A small striping wheel may be used for adding fine border lines to the glass on the same side the picture is on, that is, the back. When the lines dry, the whole back is painted with quick-drying enamel.—J. H.



Dry Powdered Pumice Stone Lightens Print Shadows

PRINTS in which the shadows are too dense can be reduced locally by rubbing with a bit of cotton and some powdered pumice stone. The method is also a good one for cleaning up degraded high lights. The powder is used dry, and the excess may be wiped away easily afterwards.—E. V. B.

• • •

WHEN moisture is absorbed by color transparencies, it condenses over the cover glass upon projection and blurs the image. To avoid this, coat the emulsion, which must be thoroughly dry, with film lacquer.

Rocking Film-Tank Agitator Made from Bread Pan

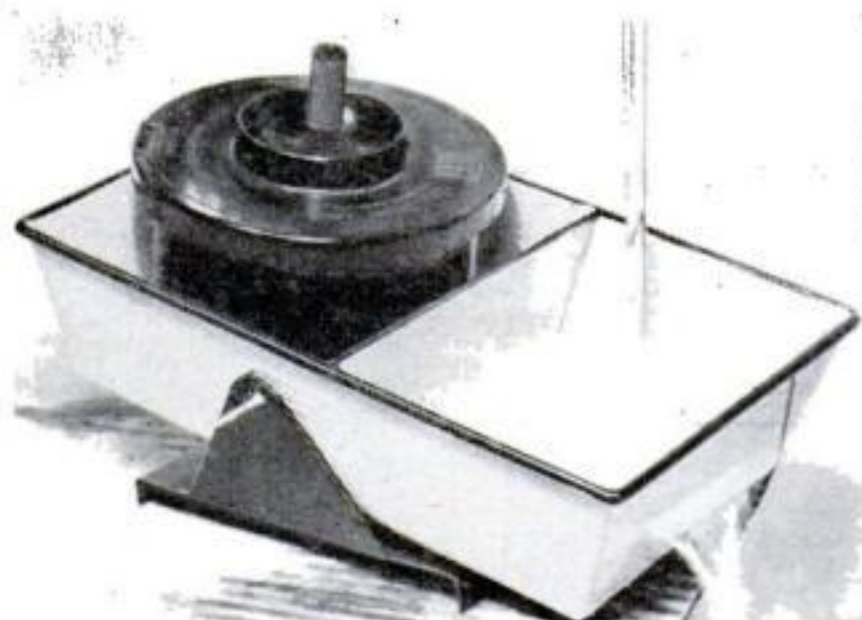
THIS film-tank agitator may be made from a ten-cent bread pan and a nickel's worth of light sheet metal. It is of the rocking type and operates from a water tap.

A bread pan about 6" by 10" will do for film tanks of ordinary size. A partition cut from the sheet metal is soldered into the pan to form two compartments as shown. One should be just large enough to hold the tank. Two pivot pins—large-headed nails—are driven through the sides in such a position that when the tank is loaded and placed in its compartment, the weight will hold the tank end down, but when a slight pressure is added to the other end, it will tilt. The pins are soldered in place.

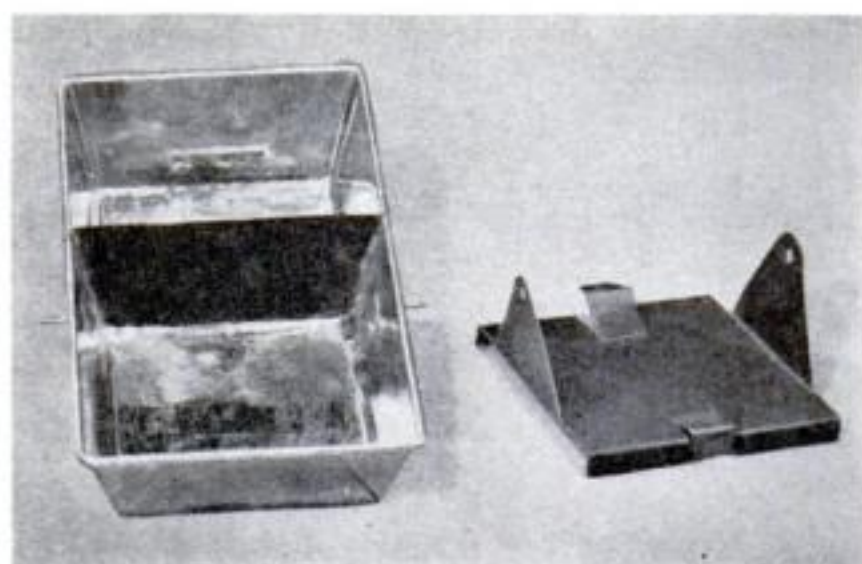
The base is cut from sheet metal and bent to shape. A hole is drilled into the end of each base upright for the pivot pins. Cuts are then made in both ends of the base, and the resulting strips bent up as illustrated to form the stops that govern the amount of tilt the pan will have. These are set so that when the water compartment is up, it will be a little above level; and when it is down, it will be about 1½" below level. The unit is assembled by placing the pivot pins through the holes in the uprights.

The "spill" slot must now be cut into the end of the water compartment. Its position may be determined by placing the loaded film tank in position and turning on the water until the compartment fills just enough to tilt the pan. The water is turned off, and with the pan in the "up" position, the water level is marked on the end of the pan. A 2" by ½" slot is cut lengthwise with this water line as a guide for the lower side of the slot. The unit should be enameled.

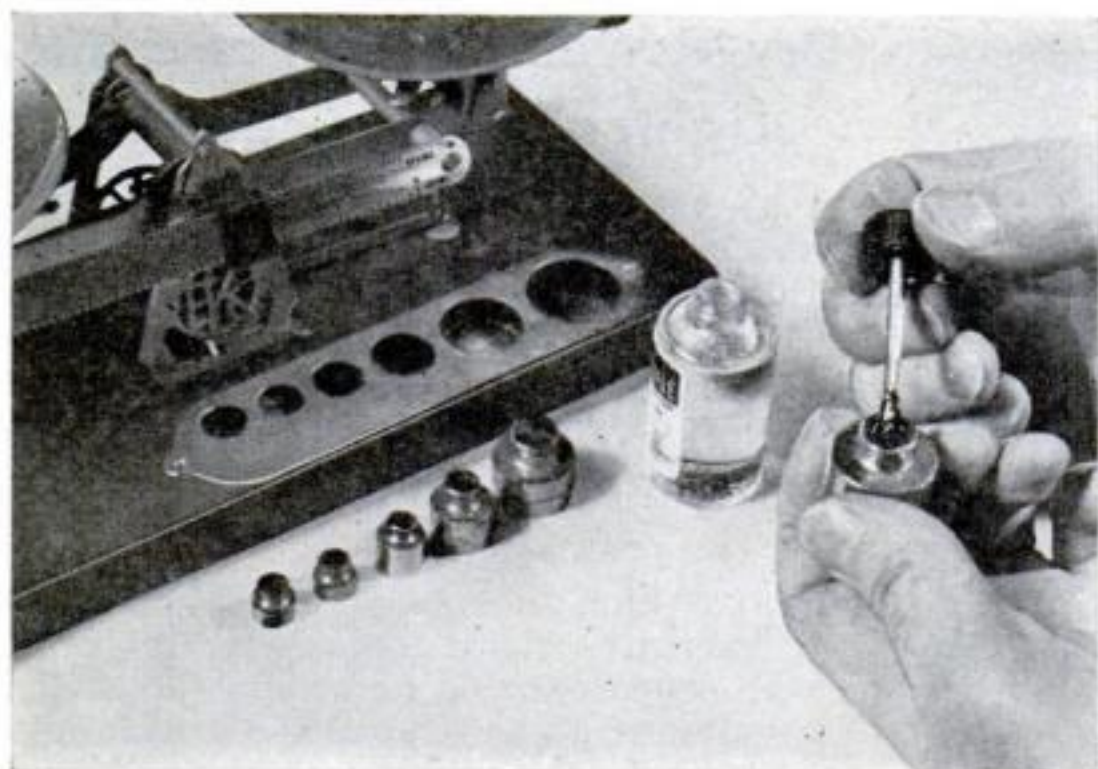
In use, the film tank is loaded and put in its compartment; then the entire outfit is



Water spilling from the slot in the pan. Below, the pan before being enameled, and the base unit



placed under the water tap and water is directed into the pan in a small stream. When the water level rises to the slot, the pan tilts, thus spilling the water and allowing it to rock back again. A satisfactory speed is a complete cycle every three seconds.—HOWARD W. ROZELLE.



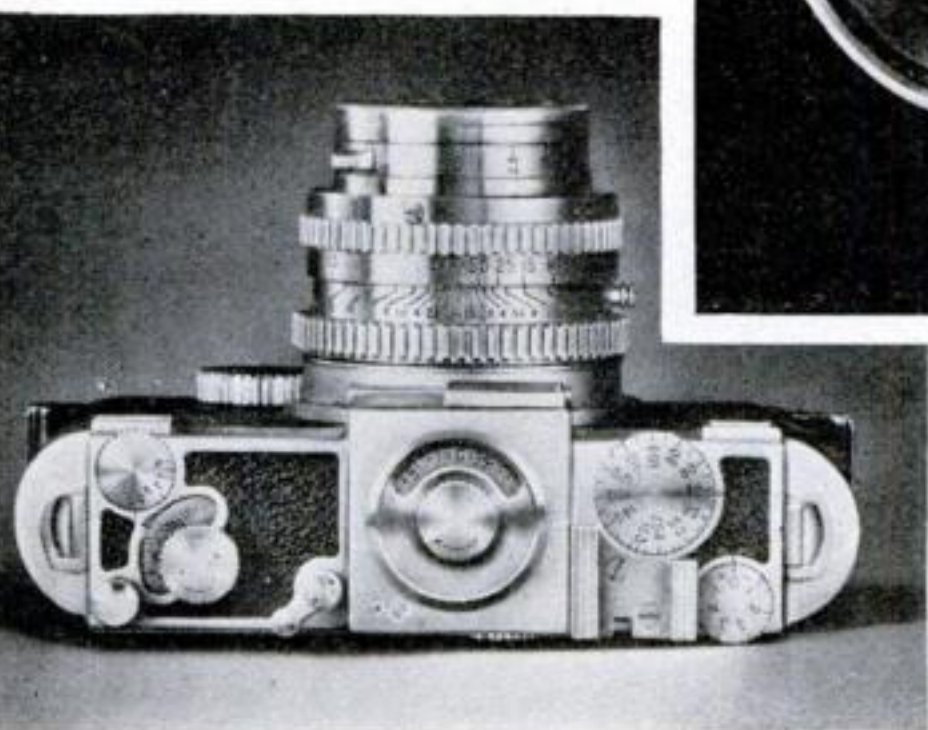
Scale Weights Protected with Coat of Lacquer

AFTER a new darkroom scale has been in use for a short time, exposure to chemicals will cause corrosion of the weights, and in time the figures become hard to read. Clean the weights with steel wool and dust off any fine particles; then apply a coating of clear finger-nail polish or similar lacquer. When dry, this will form a tough film that will keep the weights in new condition indefinitely.—K. L. R.

AMERICAN-MADE

Miniature Camera

BIDS FOR
WORLD SUPREMACY



Interchangeable magazine backs are one of many unique features found in this new 35-mm. camera. Above, fitted with f/1.9 lens. Left, a top view

FEATURES never before available in any 35-mm. camera—even the most costly foreign models—are incorporated in a new camera with which America now bids for supremacy in the miniature field. Nothing has been overlooked to give amateur and professional photographers the utmost in precision, versatility, and all-around operating convenience.

Known as the Kodak Ektra, the camera is the first to provide interchangeable magazine backs for 35-mm. film. The magazine backs make it possible to switch from one type of film to another in the middle of a roll, quickly and without loss of a single frame.

Basically, the camera consists of three units—the camera body, any of six special lenses ranging from 35 to 153 mm. in focal length, and a magazine back. With more than one lens, and more than one back loaded with different types of film, a remarkable degree of flexibility is obtained. Changing from black-and-white film to

Kodachrome or from a lens of normal focal length to a telephoto or wide-angle lens, is a matter of seconds.

The focal-plane shutter gives speeds from one to 1/1000 second and "bulb." The range finder is said to be the most accurate on any miniature camera and will couple with all focal lengths of the lenses. It is adjustable for individual vision. A variable-power view finder, which is set by a simple dial for lenses of focal lengths from 50 to 254 mm., corrects automatically for parallax, and also has an adjustment for individual vision.

All operating controls are at the finger tips of one hand. The scales and dials are visible from the top of the camera. Rapid film advance and rewind are provided, with a visible indicator actuated by the film itself. Advancing the film simultaneously resets the shutter for another exposure.

Other refinements include an automatic exposure counter on the body and a manually set exposure indicator on each magazine back; a visual signal which shows after each exposure until the film is advanced; positive prevention of accidental double exposures; a velvet-smooth shutter release plunger designed to eliminate release shock, and a delayed-action mechanism for

self-portraits and work of a similar nature.

The focal-plane shutter provides a fine "preselected" slit, the width of the slit being established as the shutter dial is set—not during the exposure. Each shutter is tested by a photo-electric scanning system. Shutter speeds above 1/25 second are selected by a lift-and-set dial; slower speeds, by an auxiliary dial with red numbers.

Other controls on top of the body include the selector dial for adjusting the view finder field to match the lens in use; the exposure counter dial; "exposed" signal; dial for setting the range finder to the user's vision; and a small red dot indicating the focal plane, which is used for measuring of film-to-subject distance in extreme close-up work.

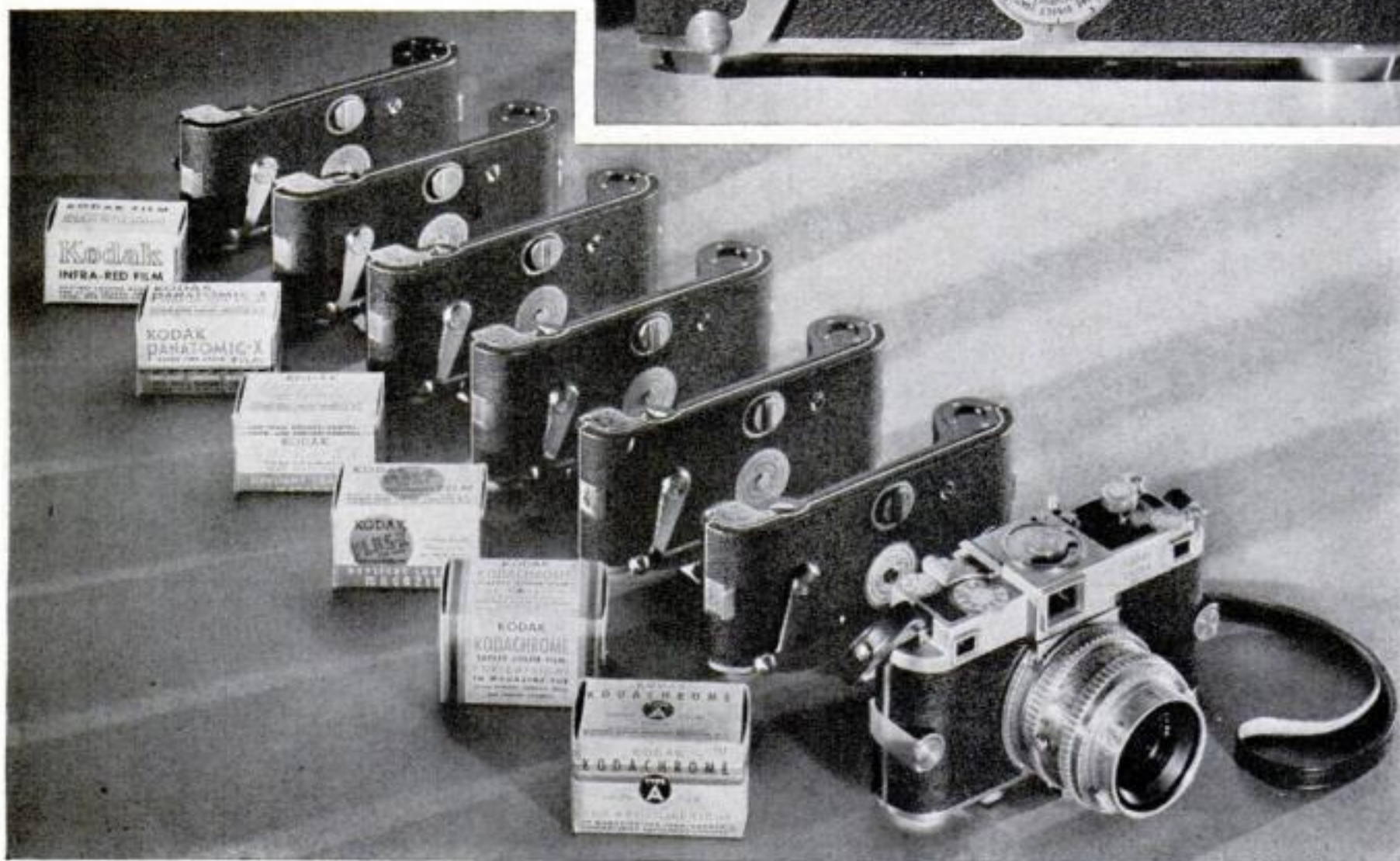
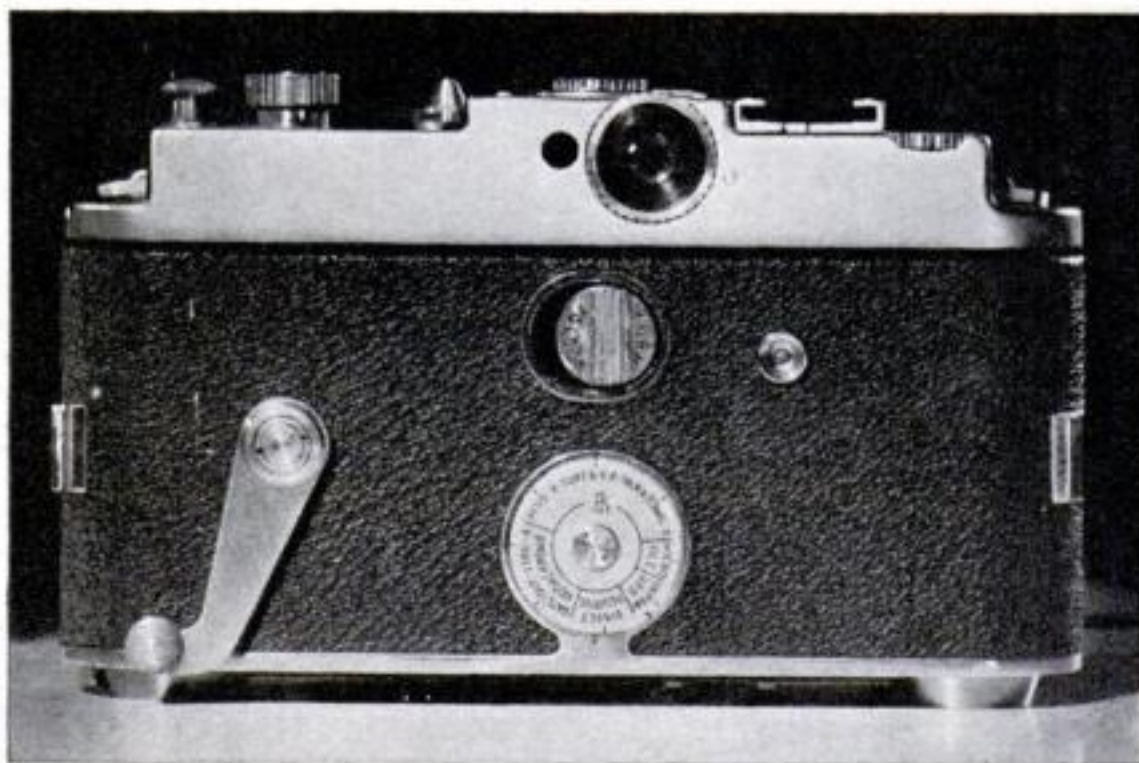
The range finder is of the split-field, telescopic, military type, and couples automatically with every lens designed for the camera. It uses a base longer than any other similar built-in system on a 35-mm. camera. When the range finder is adjusted, automatic parallax compensation takes place in the view finder for whatever lens is in use. The compensation is accomplished by an internal optical arrangement, and not by a mechanical movement of the whole finder.

Right, a rear view with magazine back in place. Two flicks of thumb against lever at left advance the film and set the shutter. Below, a set of the backs

Recesses at either end of the body accommodate the spool chambers of the magazine backs. The backs load in the same manner as most miniature cameras. Each back has a manually set exposure-count dial, mechanism for moving the film, a visual indicator to check on film movement, and a metal slide that automatically covers the film opening as the back is unlocked from the camera body.

Film winding is accomplished by a small lever. Two quick flicks of the thumb, and the photographer is ready for another shot.

Lenses announced for the camera are Kodak Ektars, all surface-treated to increase the efficiency with which light is transmitted. Those now available are: f/3.3, focal length 35 mm. (wide angle); f/1.9, 50 mm. (normal); f/3.5, 50 mm. (normal); f/3.5, 90 mm. (moderate long-focus, especially suited to informal portrait photography); f/3.8, 135 mm. and f/4.5, 153 mm. (both telephoto).



12,000,000 SUCCESSFUL SNAPSHOTS AT NIGHT

Taken by average picture takers
last winter



Night Snapshots simple as A.B.C. with **KODAK SUPER-XX FILM**

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A... Load your present camera with Kodak Super-XX Film.

B... Use a couple of inexpensive Mazda Photo-flood lamps in Kodak Handy Reflectors. (You keep your Reflectors, folded flat, in their attractive box. Kodak Handy Measure included.)

C... Follow the few simple directions in the FREE booklet. Like shooting with an expert at your elbow. Brief, easy-to-follow instructions and diagrams, exposure table, picture suggestions.



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MIXED IN A MOMENT—in cold water. No heating. No waiting.

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Here's my 10c. Send me trial can and booklet, "Mighty Facts on Cascamite".

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Plastic Bodies for Cars

(Continued from page 131)

That means the elimination of torn metal and dangerous jagged edges in collisions. In the second place, while tensile strength resistance to steady strain—of the plastic is less than that of steel, volume for volume, the panels will be thicker and will be backed up by the sturdy tubular steel frame which, Ford says, "will take care of that." On top of it all, the car will have less dead weight to cause collision damage.

Significantly, Ford places greater safety below lower cost in the list of advantages in his plastic cars. He says also that they will be warmer in winter and cooler in summer because of less heat transfer than steel affords. They will be quieter, too, by reason of the material's sound-deadening qualities, and metallic ring will be eliminated.

Another problem Boyer solved was the added time required for the heat-and-pressure-molding process that his plastics must undergo, as compared with sheet-steel stamping. Just six times as much, in fact. So to cut the time down to the requirements of the production line, Boyer will place six identical dies at once in each press, stacked up like dishes, and get six panels from a single operation.

As in most new industrial ventures, the list of manufacturing problems is long, and the time it may take to solve them cannot be estimated. That the bulk of them are solved for plastic cars becomes evident from the air of excitement and enthusiasm among researchers at the Ford plant. Ford himself lets few days go by without looking in on the chemical-laboratory operations and consulting with Boyer and his associates. And no one is stirred more than Ford at the prospect of seeing that all-plastic-bodied car.

He will see it, in Boyer's test car, early this spring. And the word going around Dearborn and near-by Detroit is that the first mass-production plastic car will be on the market in from one to three years. Ford will not predict the actual date.

"I don't know what I'll be thinking tomorrow," he says in reply to a question on the point.

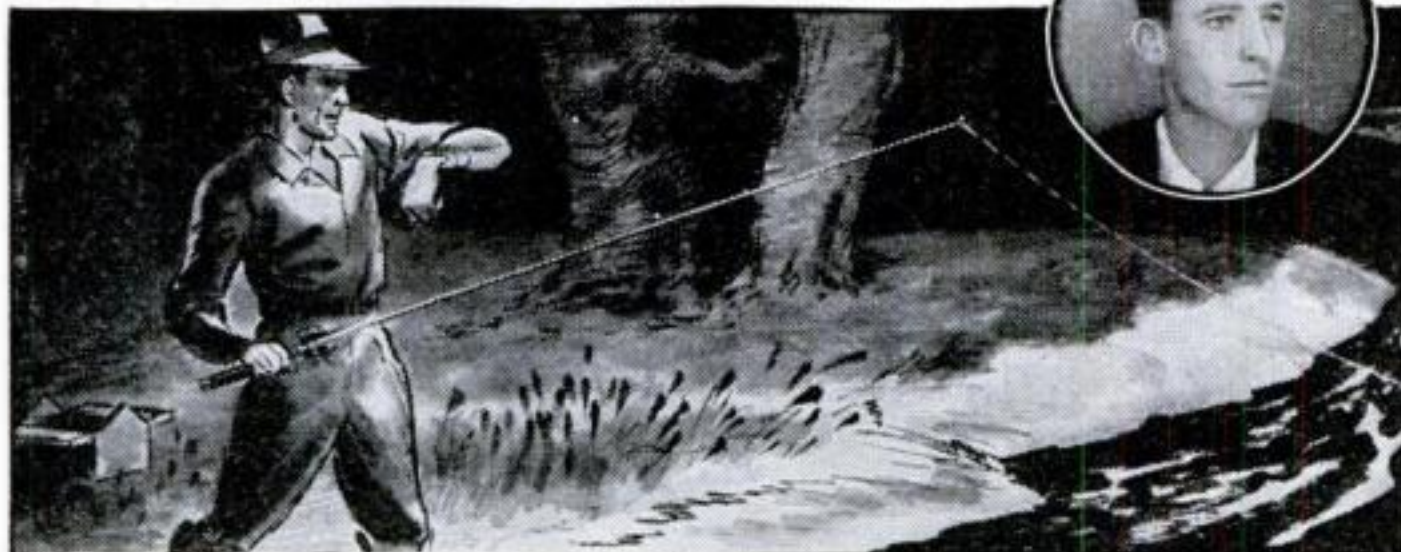
But his close associates do know what he's thinking most about today.

Question Bee Answers (Page 126)

- | | | | | |
|------|------|------|------|-------|
| 1. c | 2. c | 3. c | 4. b | 5. c |
| 6. a | 7. b | 8. c | 9. b | 10. a |

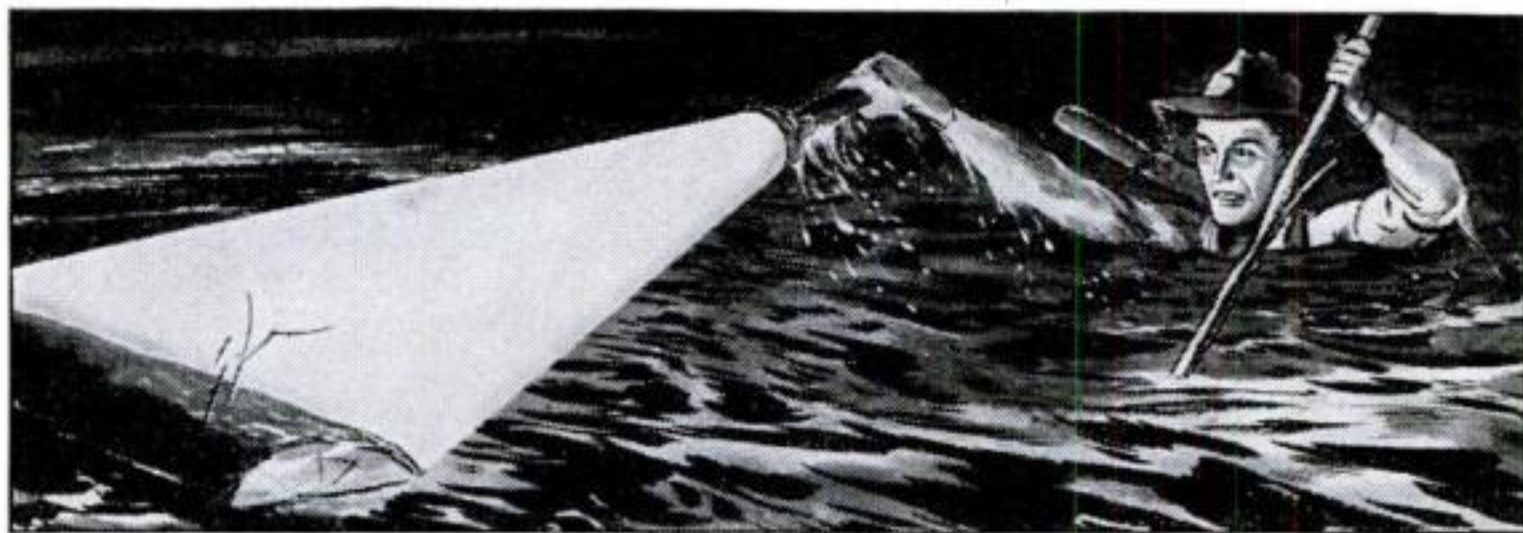
"BLACK DEATH CLOSED IN ON ME!"

A true experience of WILBUR MOSLEY, Mt. Airy, N. C.



"TORRENTS OF RAIN had been coming down all afternoon when I arrived at my favorite fishing spot—a place where the river turned at a sharp angle. My luck was so good that I lost track of time until I glanced at my watch at 10 P.M.

"HASTILY GATHERING UP my equipment, I started back to my car. Suddenly, to my horror, I saw that on each side of me was a hundred yards of black rushing water. The river had overflowed its banks and even now was engulfing my 'island.'



"WITH THE AID of my flashlight and a pole for sounding the water's depth, I struck out into the flood. Sometimes I slipped into water over my head—but the drenched flashlight burned on—and I reached higher ground. Believe me, that night 'Eveready' fresh DATED batteries saved my life!

(Signed) *Wilbur M Mosley*

Note: An "Eveready" flashlight with "Eveready" batteries, will normally continue to burn under water.

The word "Eveready" is a registered trade-mark of National Carbon Company, Inc.



FRESH BATTERIES LAST LONGER... Look for the DATE-LINE

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TOUGH on Oil-Pumping • GENTLE on Cylinder Walls

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Note to Used Car Buyers: Ask the dealer if it's Steel-Vent Reconditioned. It's a better buy if it is.

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Toronto and Winnipeg



HASTINGS
STEEL-VENT PISTON RINGS
Stop Oil-Pumping
IN CARS, TRUCKS AND TRACTORS

Gus Solves an Army Job

(Continued from page 142)

grinned and muttered: "I'll bet that's it!"

He inserted a test prod in each terminal eye of the flexible wire. His test lamp flashed on. He pulled gently on the eyes to stretch the wire. The test lamp went out. He released the tension on the wire. The lamp flashed on again.

"Found it!" he said triumphantly.

"Yes," General Handley said, "You've located the trouble—but what the devil is the trouble?"

"The wire's broken inside its insulation," Gus told him. "Whenever the engine speed changes, the automatic spark causes the plate in the distributor to shift its position. That frequent motion has resulted in the wire breaking. When the ends of the broken wire happen to touch, the engine runs all right, but when they move apart, the engine misses and stops."

He handed the wire to the general. "If you'll pull on it, and then relax the tension, you'll feel the broken ends rubbing against each other," he said.

General Handley nodded. "I call that pretty smart trouble shooting," he said. "you've lived right up to your reputation, Mr. Wilson."

Gus looked sort of pleased, but he shook his head. "I should have spotted it quicker," he said. "I've never run into that exact trouble before, but we've had several cases pretty much like it."

It didn't take Harry and him long to install a new flexible wire and get the distributor back in place. When the job was finished the general thanked Gus and told him he'd like to have him as his motor transport officer, and then shook hands all around. By that time we all were feeling easy and natural with him—that is, all of us except Ez Zacharias, who kept on standing up stiff as a ramrod, and who, when the general got into his car, gave him a snappy salute that made everyone feel foolish. Then Harry said "So long," and drove out.

George Knowles was the first to say anything. "If all generals are like that one," he told us, "I wouldn't mind being in the Army myself . . . Say, Ez, how come you didn't tell him where to head in? You said you'd been waiting twenty years for the chance!"

We looked around for Ez, but he wasn't there, and a few seconds later we heard the honk of his horn as he headed out of the driveway.

Gus laughed. "It'll be a long time before Private Zacharias hears the end of that."



I AM PLEASED TO ANNOUNCE that the activity of the Ford Good Drivers League will be broadened in 1941. This year, girls as well as boys will be admitted to membership. The enthusiastic support given the League in its first year by educational, safety, and civic organizations is gratefully acknowledged. I believe that the work of the League in 1941 will be equally interesting to these groups.

To all boys and girls between the ages of 14 and 18 inclusive, I extend a cordial invitation to join the Ford Good Drivers League and participate in its activities.

Edsel Ford

EDSEL FORD

Announces

**THE 1941 GOOD DRIVERS LEAGUE PROGRAM
FOR BOYS AND GIRLS OF AMERICA**



98 University Scholarships for Skillful Driving

In its second year the Ford Good Drivers League offers girls, as well as boys, an opportunity to become more skillful drivers. Boys against boys in one division; girls against girls in another division. 98 scholarships (49 for each division) will be awarded to winners in Good Driving Contest.

Membership in the Ford Good Drivers League is open to any boy or girl who lives in the United States, who is between 14 and 18 years of age inclusive, and who is legally authorized to drive an automobile. An enrollment card may be secured from any Ford or Lincoln and Mercury

dealer, or by writing to the Ford Good Drivers League, Dearborn, Michigan.

Those who join the League will receive, without charge, a membership card, a membership button, an illustrated book, "How To Become A Skilled Driver," and full details of the nation-wide driving contest. 98 scholarships (49 for boys and 49 for girls) will be awarded to the 98 State Winners competing in the National Finals in Detroit in August.

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Be among the first to enroll from your community.

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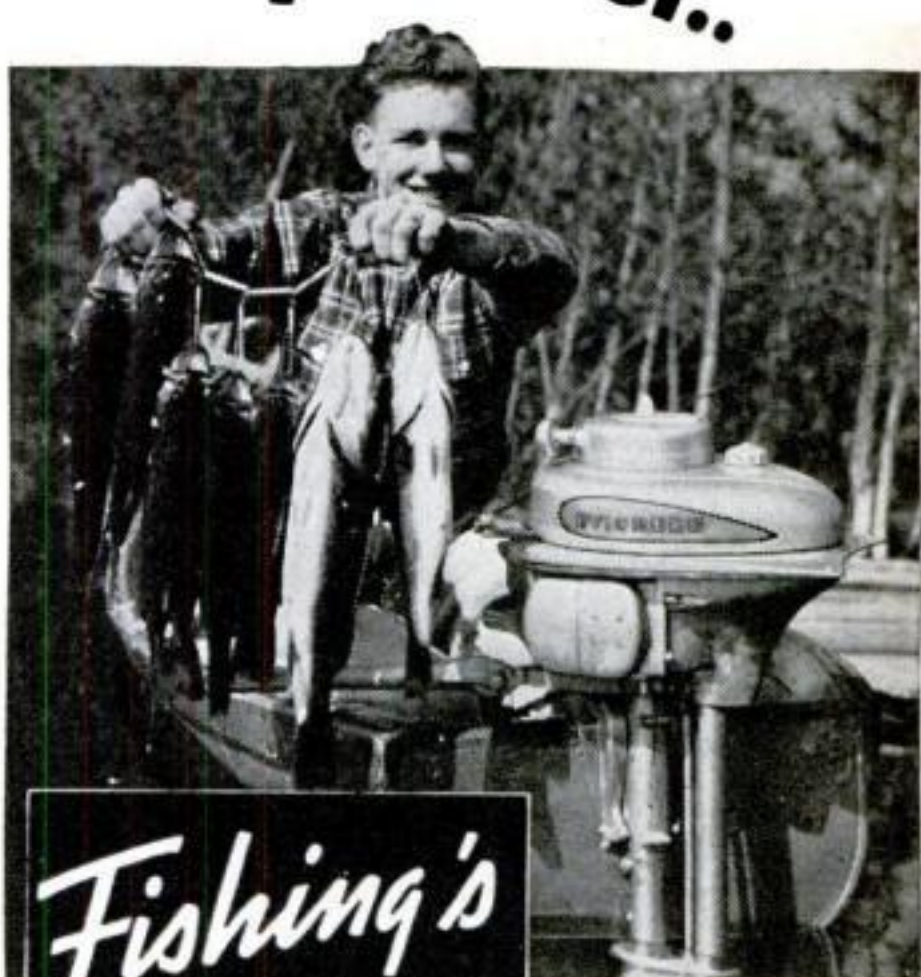
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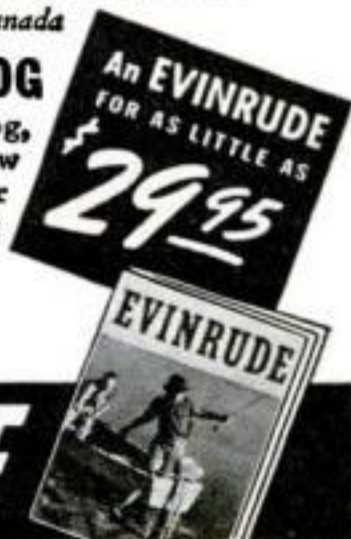
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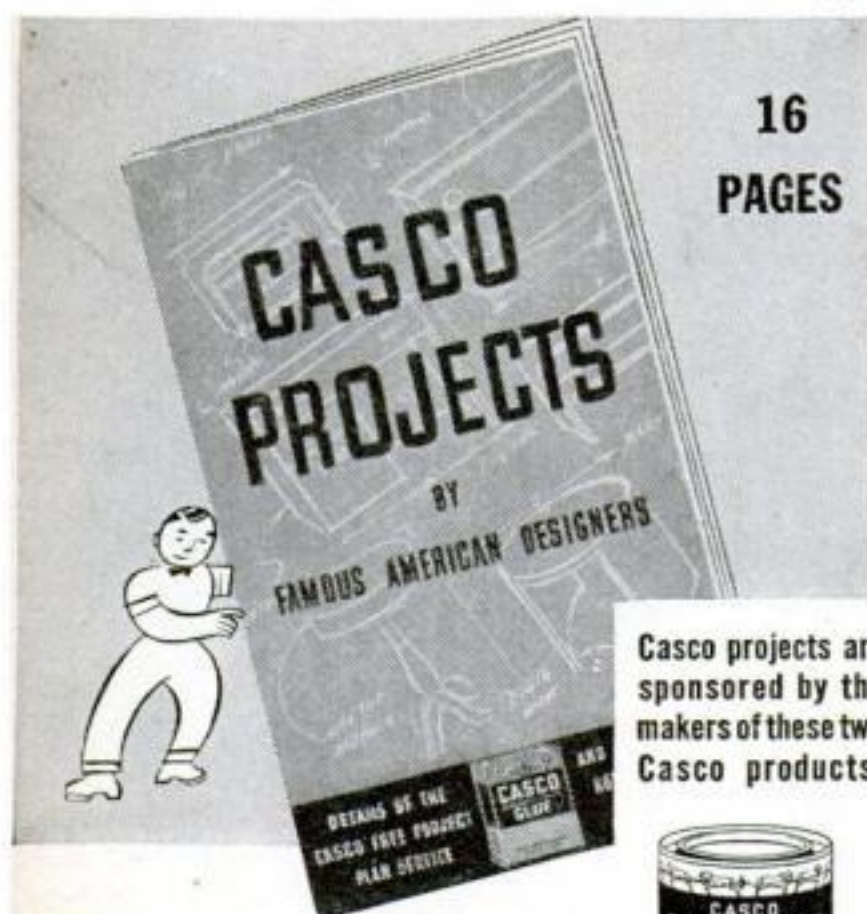
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(Continued on page 230)

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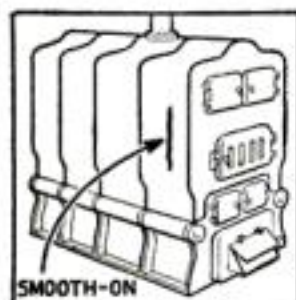
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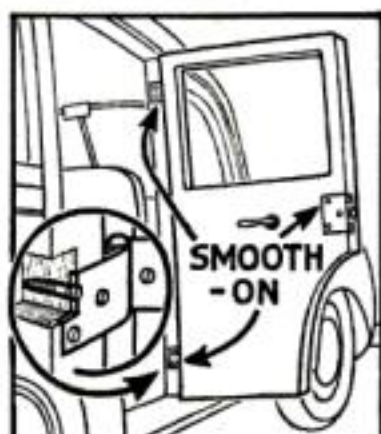
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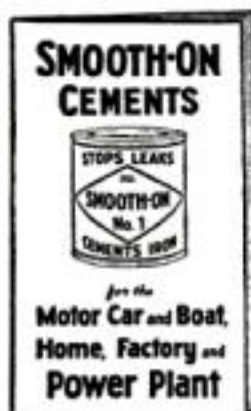


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(Continued from page 228)

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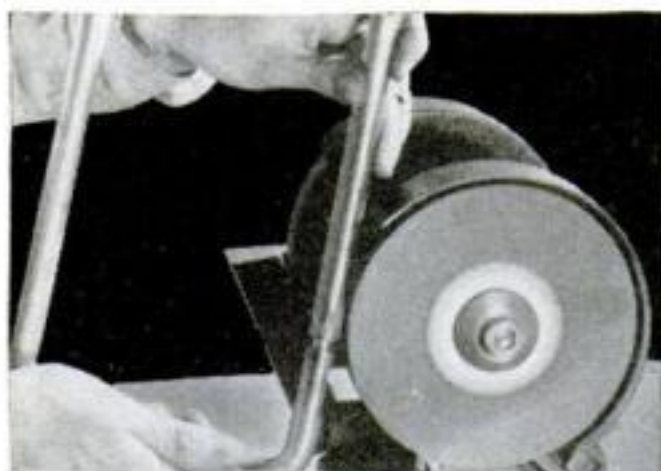
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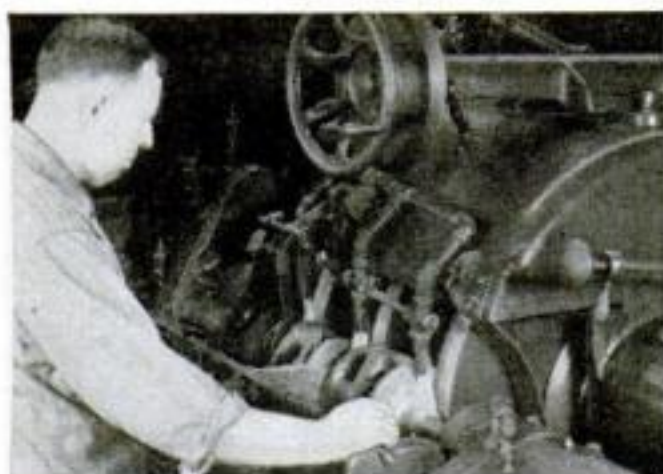
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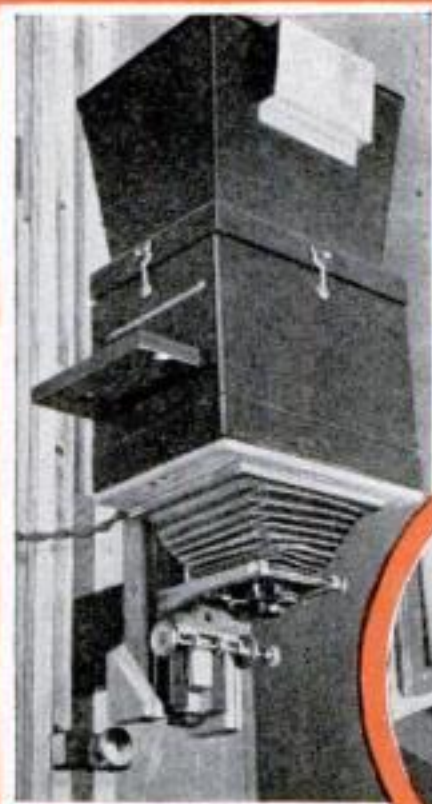
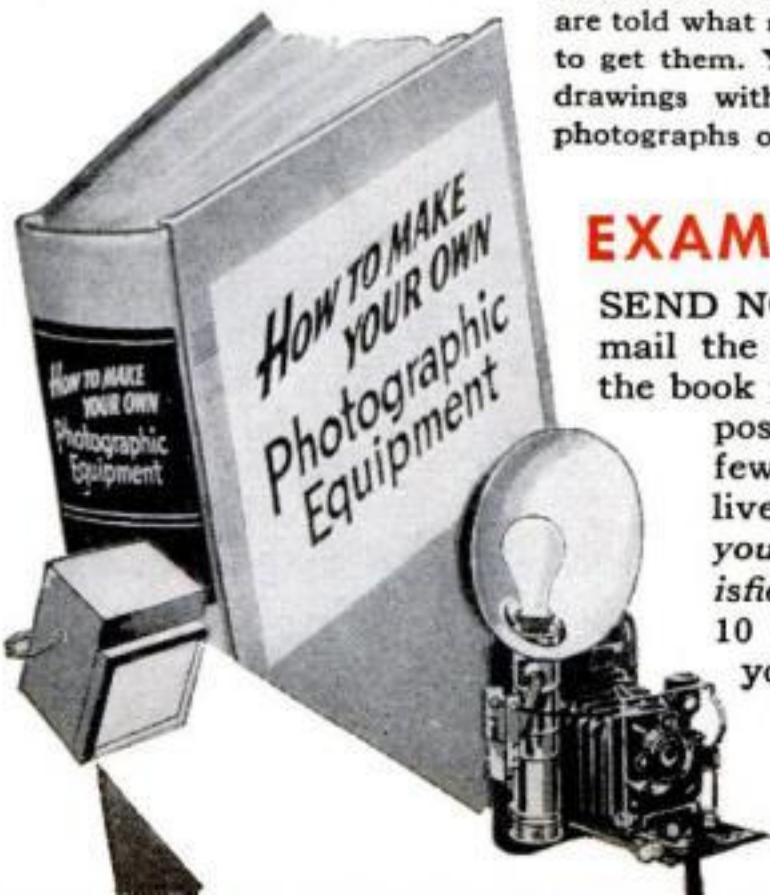
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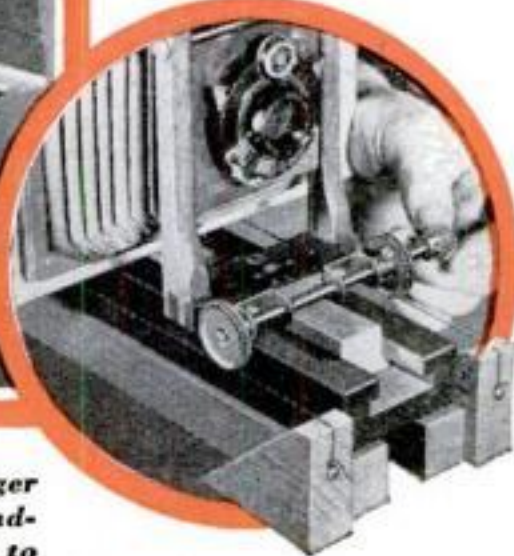
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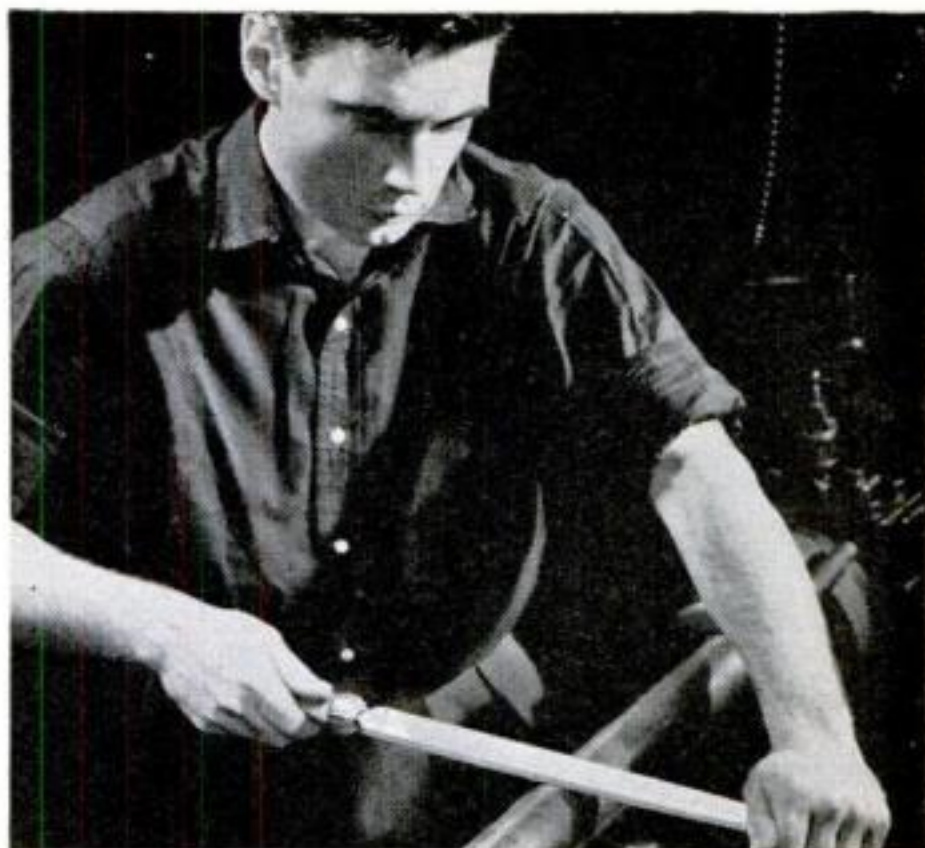
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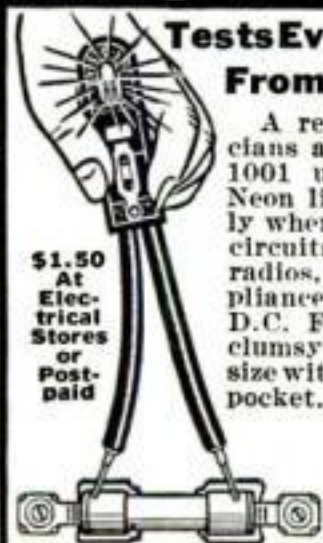
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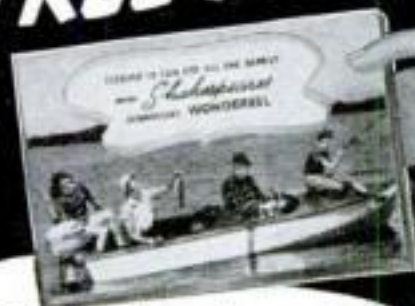
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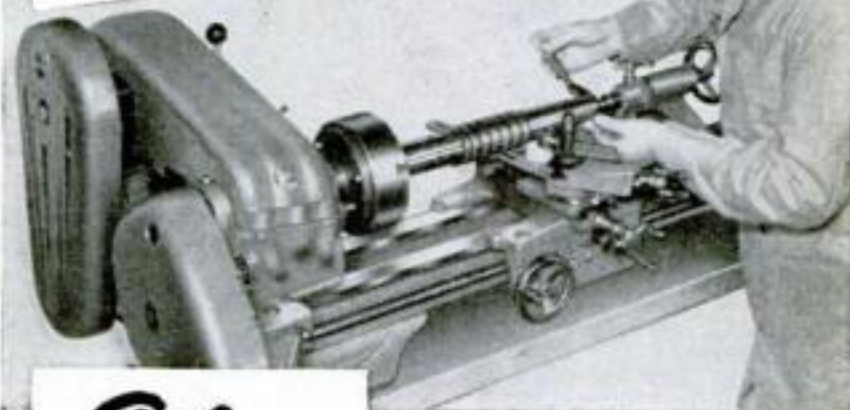
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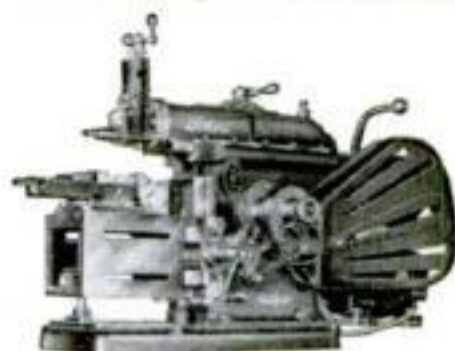


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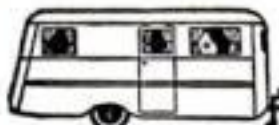
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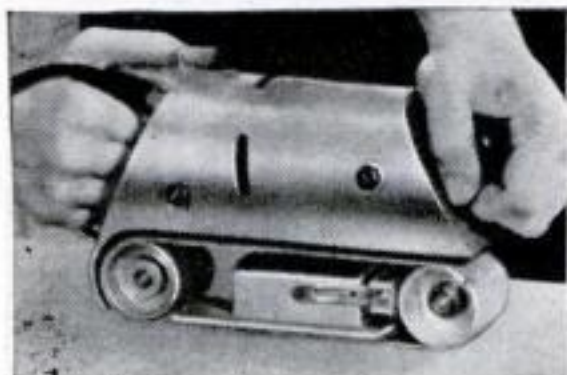
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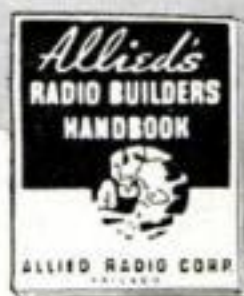
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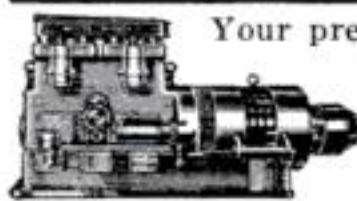
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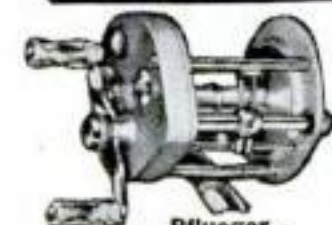
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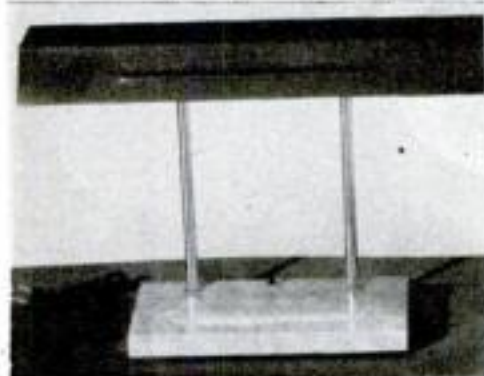


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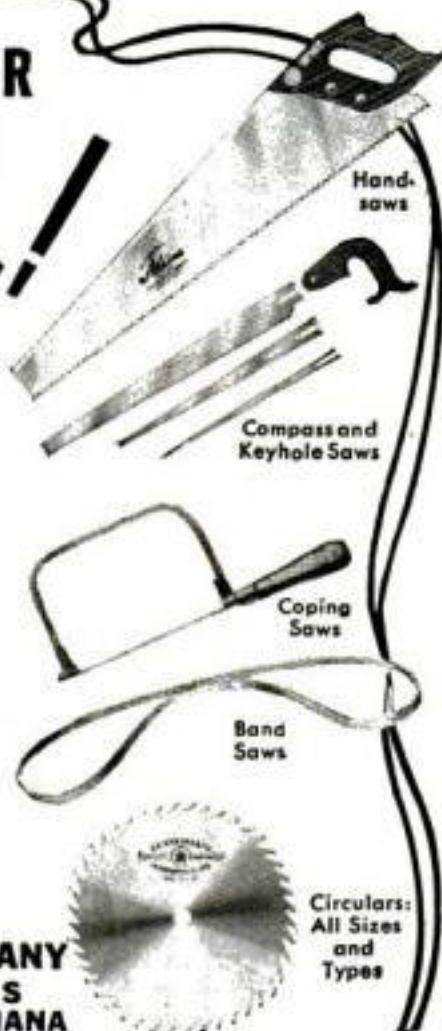
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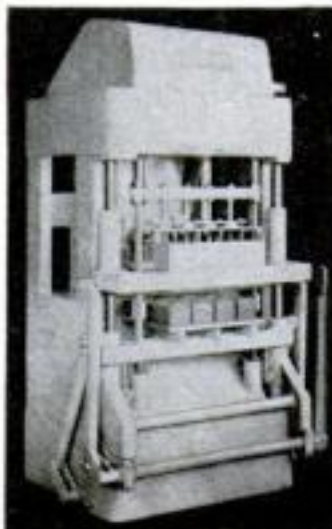
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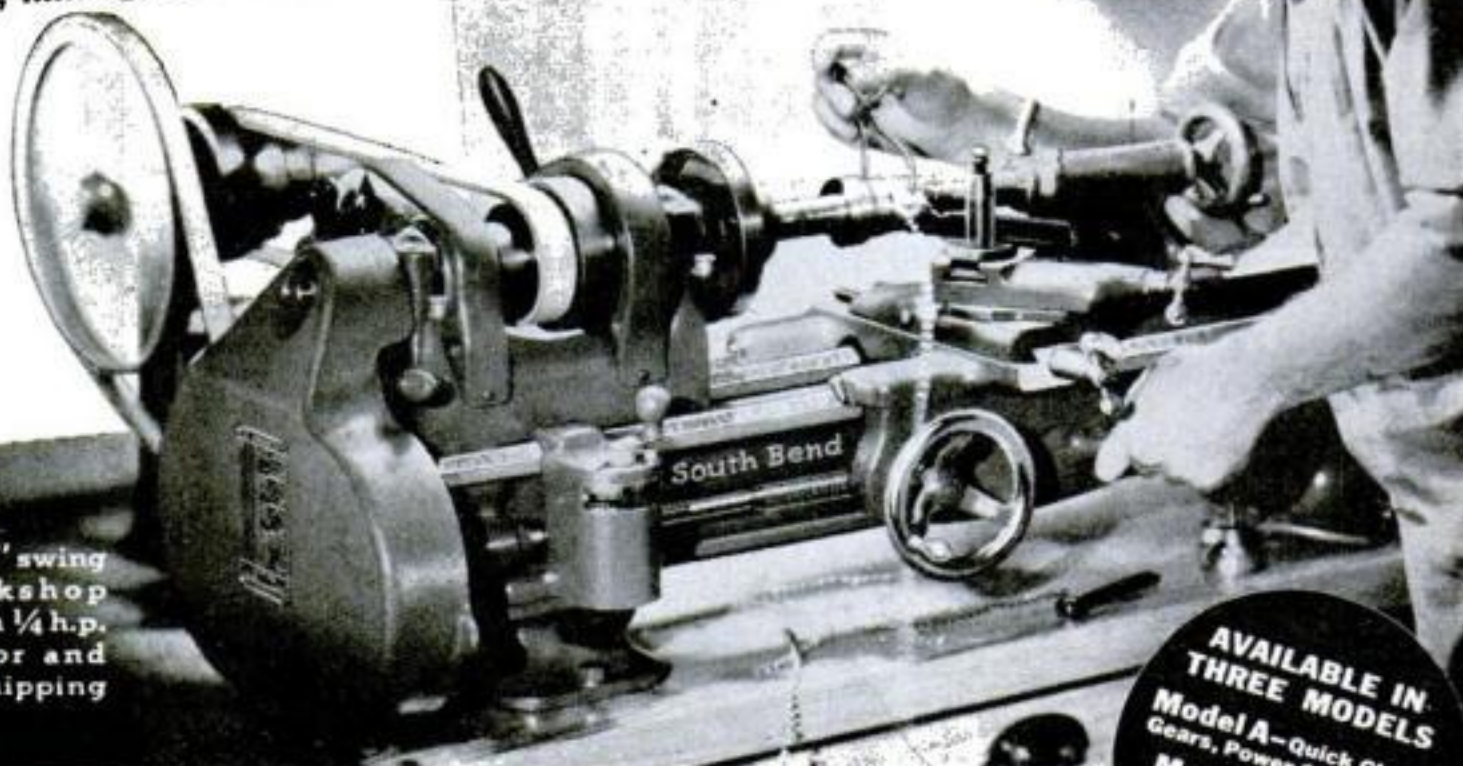
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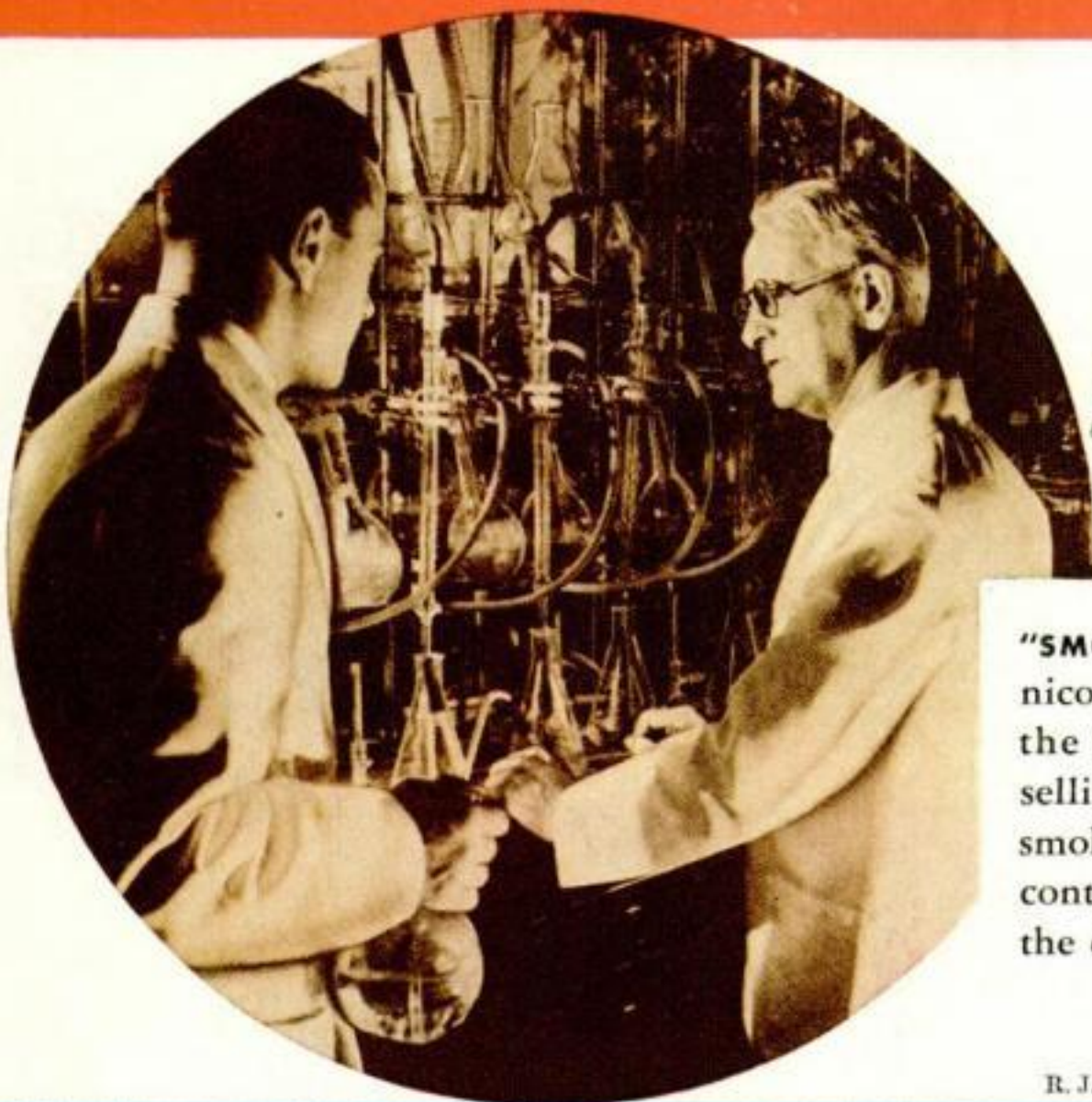
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28% LESS NICOTINE

than the average of the 4 other of the largest-selling cigarettes tested—less than any of them—according to independent scientific tests of the smoke itself



"SMOKING OUT" THE FACTS about nicotine. Experts, chemists analyze the smoke of 5 of the largest-selling brands . . . find that the smoke of slower-burning Camels contains less nicotine than any of the other brands tested.

R. J. Reynolds Tobacco Company, Winston-Salem, N. C.

CAMEL — THE SLOWER-BURNING CIGARETTE —